# THE GOLDEN CABINET:

BEING THE

# *LABORATORY,*

OR

# HANDMAID to the ARTS.

CONTAINING

Such *Branches* of *Useful Knowledge*,

As nearly concerns all Kinds of People,

From the SQUIRE to the PEASANT:

AND WILL AFFORD BOTH

PROFIT and DELIGHT.

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PART THE FIRST.

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# THE

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## Of gilding, silvering, bronzing, japanning, laquering, and the staining different kinds of substances, with all the variety of colours.

## PART I.

### *Of gilding in general.*

THE gilding different substances is performed by a variety of means accommodated to the nature of each. But the principle is the same in all; (except with respect to one kind practised on metals, where quicksilver and heat is used, which I omit here as not properly a part of the subject of this work;) being only the putting some proper cement on the body to be gilt; and then laying the gold either in the form of leaves, or powder, on the cement; which binds it to the body. The principal kinds of gilding are those called *oil gilding*;—*burnish gilding*;—and *japanners gilding*, or *gilding with gold size*. These may be promiscuously used on grounds either of wood, metal, or any other firm or rigid body: but paper and leather require a treatment in some cases peculiar to themselves. The first attention, in most kinds of gilding, is the choice of leaf gold: which should be pure, and of the colour accommodated to the purpose, or taste of the work. Purity is requisite in all cases: for if the gold be allayed with silver, it will be of too pale and greenish a hue for any application; and if it contain much copper, it will in time turn to a yet much stronger green. The purity may be ascertained with

accuracy enough for this purpose, by the touchstone, and *aquafortis*; and the fitness of the colour, to any particular purpose, may be distinguished by the eye. The full yellow is certainly the most beautiful and truest colour of gold: but the deep reddish cast has been of late most esteemed from the caprice of fashion. Whichever may be chosen, the colour ought nevertheless to be good of the kind; for there is a great variation in the force and effect of different parcels of the same teint; some appearing more foul and muddy; others bright and clear. The best method however of judging of the colour of leaf gold with nicety, is by keeping a specimen of such as is perfect; with which any fresh parcel may be occasionally compared. There is, besides the true leaf gold, another kind in use, called Dutch gold: which is copper gilt, and beaten into leaves like the genuine. It is much cheaper; and has, when good, greatly the effect of the true, at the time of its being laid on the ground; but with any access of moisture, it loses its colour, and turns green in spots; and, indeed, in all cases, its beauty is soon impaired, unless well secured by laquer or varnish. It is nevertheless serviceable for coarser gilding, where large masses are wanted; especially where it is to be seen by artificial light, as in the case of theatres: and if well varnished, will there in a great measure answer the end of the genuine kinds. The other preparations of gold, belonging to particular kinds of gilding, I shall treat of them, as likewise the cements or other substances employed, in their respective places; and proceed now to show, what the instruments are, which are common to the three principal methods.

*Of the instruments that are common to oil, burnish, and japanners, gilding.*] The first necessary instrument is, a cushion for receiving the leaves of gold from the paper, in order to its being cut into proper size and figures, for covering the places to be gilt. This cushion should be made of leather, and fastened to a square board, which should have a handle. It may be of any size from fourteen inches square to ten; and should

be ſtuffed betwixt the leather and board with fine tow or wool; but in ſuch a manner, that the ſurface may be perfectly flat and even. A proper knife is the next, and an equally requiſite inſtrument; as it is neceſſary in all caſes to cut or divide the gold into parts correſpondent to thoſe, which are to be covered. This knife may be the ſame in all reſpects as thoſe uſed in painting, called *pallet knives*; the blade of which may be four or ſix inches long, and ſomewhat more than half an inch in breadth, with a handle proportionable. A ſquirrel's tail is likewiſe generally provided, for taking up the whole leaves, and for compreſſing the gold to the ſurface where it is laid, and giving it the poſition required. It is uſed alſo by ſome for taking up the parts of leaves; but this is better done by means of a ball of cotton wool; which will both anſwer this end, and that of compreſſing the gold in a more eaſy and effectual manner. This ſquirrel's tail is cut ſhort, and ſometimes ſpread in the fan-faſhion by means of a piece of wood formed like a pencil ſtick, but broad at one end, and ſplit to receive the tail; but it will equally ſerve the purpoſe in its own form, when the hair is cut to a proper length. This inſtrument is by ſome called a *pallet*; but improperly; as the board for holding the colours in painting, and which is frequently in uſe along with this, being called by the ſame name, would neceſſarily produce a confuſion in ſpeaking of either. A bruſh of very ſoft hog's hair, or of the fitch kind, made large, is likewiſe commonly uſed for paſſing over the work when it is become dry, in order to take off the looſe gold. Some fine cotton wool is alſo neceſſary for taking up the ſmaller parts of the leaves, and laying them on the work: as alſo for compreſſing and adjuſting them when laid on. The cotton ſhould be formed into a ball, by tying it up in a piece of fine linen rag; for if it be uſed without the rag, the fibres adhere to the gold ſize, and embarraſs the work. A ſmall ſtone and muller, with a proportionable palate knife, are required for grinding and tempering the mixtures made of the fat oil, or gold ſize, with each other, and the co-

lours that may be added to them. Proper brushes are also wanted for laying on, and spreading the fat oil, or size, on the work: and some of these should be pitches of different sizes; in order to convey and settle the gold, where the relief of carved work forms deep hollows. These are all the instruments that are common to all the three principal kinds of gilding; such as are peculiar to each, I shall take notice of where they more properly occur.

*The manner of oil gilding, and the preparation of fat oil.*] The gilding with oil is the most easy and cheap, as well as most durable kind; and therefore, is mostly applied to common purposes. It is performed by cementing the gold to the ground, by means of fat oil. The preparation of which is, therefore previously necessary to be known; and may be much better managed in the following manner, than by any method hitherto taught, or commonly practiced.——" Take any quantity of linseed oil, and put it into an earthen, or any other vessel of a broad form, so that the oil may lie in it with a very large surface; but the proportion should be so limited, that the oil may be about an inch thick in the vessel. The earthen pans used for milk, in the forming cream for butter, are very well accommodated to this purpose. Along with the oil as much water should be also put into the vessel, as will rise six inches or more above the bottom. Place the vessel then, with the oil swimming on the water, in any open place where the sun and rain may have access to it; but where it may be as free from receiving dust and filth as possible. Let it stand in this condition, stirring the contents on every opportunity, for five or six weeks, or till it appear of the consistence of treacle. Take the oil then from off the water into a phial, or bottle of a long form, or what is better, into a separating funnel, such as is used by the chemists, and there draw off the remainder of the water. Place it afterwards, being in the long bottle or phial, in such heat as will render it perfectly fluid; and the foulnesses it may contain will soon subside to the bottom; when the

clear part muſt be poured off; and the remainder ſtrained through a flannel, while yet water, and the whole will then be fit for uſe."——It is to be obſerved, that this method is only practicable in ſummer; as the ſun has not ſufficient power in winter to produce a due change in the oil. This method differs from that commonly practiſed, in the addition of the water; which ſuffers the foulneſs to ſeparate from the oil, and ſink to the bottom; where it remains without being again mixed with the oil every time it is ſtirred, as is unavoidable where no water is uſed. The water likewiſe greatly contributes to bleach the oil, and improve it in other reſpects. The beſt previous preparation of the piece to be gilded, if it have not already any coat of oil paint, is to prime it with drying oil mixed with a little yellow oker; to which, alſo, a very ſmall proportion of vermillion may be added. But where greater nicety and perfection is required in the work, the wood ſhould be firſt rubbed with fiſh ſkin; and then with Dutch ruſhes. This priming being dry, the next part of the operation is the ſizing the work; which may be done, either with the fat oil alone, (but diluted with drying oil, if too thick to be worked without) or with fat oil, and the japanner's gold ſize, (of which the preparation, is below taught) either in equal quantities, or in any leſs proportion, with reſpect to the gold ſize. The difference betwixt the uſe and omiſſion of the gold ſize, in this way of gilding, lies in two particulars. The one is, that the ſizing dries faſter according to the proportion of the quantity of the gold ſize to the fat oil, and is conſequently ſo much the ſooner fit to be gilded. The other is, that the gilding is alſo rendered, in the ſame proportion, leſs ſhining and gloſſy; which is eſteemed a perfection in this kind of gilding: though, taking away the prejudice of faſhion, I ſhould think the moſt ſhining the moſt beautiful; and of the ſtrongeſt effect. The fat oil, or the compound of that and the gold ſize, muſt be ground with ſome yellow oker; and then by means of a bruſh, laid thinly over the work to be gilt. But, in doing this, care muſt be

taken to pafs the brufh into all the hollows and cavities, if the fubject be carved, or have any other way, projecting parts. For where the fize fails to be laid on, the gold will never take till the work be again repaired, by going over the defective places with freſh fize: which fhould be avoided as much as poffible. Where great perfection is required, the gold fhould not be laid on the firft fizing; but that being fuffered to dry, the work fhould be again fized a fecond time: and fome who are very nice even proceed to a third. The work being thus fized, muft be kept till it appear in a proper condition to receive the gold: which muft be diftinguifhed by touching with the finger. If it appear then a little adhefive or clammy, but not fo as to be brought off by the finger, it is in a fit condition to be gilt. But if it be fo clammy as to daub or come off on being touched, it is not fufficiently dry, and muft be kept longer: or if there be no clamminefs or flicky quality remaining, it is too dry, and muft be fized over again before it can be gilt. When the work is thus ready to receive the gold, the leaves of gold, where the furface is fufficiently large and plain to contain them, may be laid on entire, either by means of the fquirrel's tail; or immediately from the paper in which they were originally put; a method, that, by thofe who have the proper dexterity of doing it, is found to be much the fimpleft and quickeft, as well as beft, for the perfection of the work. Being laid on the proper parts of the work, the leaves muft then be fettled to the ground, by compreffing thofe, which appear to want it, gently with the fquirrel's tail or cotton ball; and if any part of the gold has flown off, or been difplaced, fo as to leave a naked or uncovered fpot, a piece of another leaf, of fize and figure correfpondent to fuch fpot, muft be laid upon it. Where the parts are too fmall to admit of the laying on whole leaves, or where vacancies are left after laying on whole leaves which are lefs than require others to cover them, the leaves which are to be ufed muft be firft turned from the paper upon the cufhion (defcribed above amongft the inftruments). They muft then be cut, by fcoring over them, with the knife

(above described likewise) into such divisions or slips as may be most commodiously laid on the parts of the work to be covered. After which being separated, and taken up as they are wanted by means of the cotton wool, to which being breathed upon they will adhere, they must be laid in the places they are designed to cover; and gently pressed by the cotton, till they touch every where, and lie even on the ground. Where the work is very hollow, and small pieces are wanted to cover parts that lie deep and out of the reach of the squirrel's tail or the cotton, they may be taken up by the point of a fitch pencil (being first breathed upon) and by that means conveyed to and settled in their proper place. Those who are accustomed to it, use the pencil commodiously for a great part of the work where large parts of the leaves cannot be used. The whole of the work being thus covered, should be suffered to remain till it be dry; and it may then be brushed over by a camel's hair pencil or soft hog's hair brush, to take off from it all loose parts of the gold. If, after the brushing, any defective parts, or vacancies appear in the gilding, such parts must be again sized; and treated in the same manner as the whole was before: but the japanner's gold size alone is much better for this purpose than either the fat oil alone, or any mixture.

*Of burnish gilding; with the preparation of the proper sizes, &c.*] The gilding with burnished gold is seldom practised, but upon wood; and at present mostly in the case of carved work, or where carved work is mixed with plain. The chief difference in the manner betwixt this and oil gilding lies in the preparing the work to receive the gold; and in the substituting a size made of parchment, or the cuttings of glover's leather in the place of the fat oil, as a cement. The preparation of this size should, therefore, be previously known; and may be as follows.—"Take a pound of the cuttings of parchment, or of the leather used by glovers; and, having added to them six quarts of water, boil them, till the quantity of fluid be reduced to two quarts: or

till, on the taking out a little, it will appear like a jelly on growing cold. Strain it through flannel while hot; and it will then be fit for uſe."——This ſize is employed in burniſh gilding, not only in forming the gold ſize, or cement for binding the gold to the ground; but alſo in priming, or previouſly preparing the work. But before I proceed to ſhow the manner of uſing it ſo, it is neceſſary to give the compoſitions for the proper cement or gilding ſize employed in this kind of gilding. There are a multipilicity of recipes for this compoſition, which are approved of by different perſons: but as in general they vary not eſſentially from each other, I will only give two, which I believe to be each the beſt in their kinds. ——" Take any quantity of bole armoniac, and add ſome water to it, that it may ſoak till it grow ſoft. Levigate it then on the ſtone, but not with more water than will prevent its being of a ſtiff conſiſtence; and add to it a little purified ſuet or tallow ſcraped; and grind them together. When this is wanted for uſe, dilute it to the conſiſtence of cream, by parchment or glover's ſize, mix'd with double its quantity of water, and made warm. Some melt the ſuet or tallow, and mix it previouſly with five or ſix times its weight of chalk before it is put to the bole, to facilitate their commixture; to which in this wet ſtate they are otherwiſe ſomewhat repugnant. It is alſo ſometimes practiſed to put ſoap ſuds to the bole; which will contribute to its uniting with the tallow. ——This is the ſimpleſt compoſition, and equally good with the following, or any other; but for the indulgence of the variety of opinions, which reigns in all theſe kinds of matters, I will inſert another——" Take of bole in fine powder one pound, and of black lead two ounces. Mix them well by grinding; and then add of olive oil two ounces, and of bees-wax one ounce, melted together; and repeat the grinding till the whole be thoroughly incorporated. When this mixture is to be uſed, dilute it with the parchment or glover's ſize, as was directed in the former recipe. But till the time of uſing them, both this and the foregoing ſhould be kept

immerſed in water, which will preſerve them good."

—— To prepare the wood for burniſh gilding, it ſhould firſt be well rubbed with fiſh-ſkin; and then with Dutch ruſhes: but this can only be practiſed in the larger and plainer parts of the work, otherwiſe it may damage the carving, or render it leſs ſharp by wearing off the points. It muſt then be primed with the glover's ſize, mixed with as much whiting as will give it a tolerable body of colour: which mixture muſt be made by melting the ſize, and ſtrewing the whiting in a powdered ſtate gradually into it, ſtirring them well together, that they may be thoroughly incorporated. Of this priming ſeven or eight coats ſhould be given, time being allowed for the drying of each before the other part be put on; and care ſhould be taken in doing this, to work the priming well with the bruſh, into all the cavities or hollows there may be in the carved work. After the laſt coat is laid on, and before it be quite dry, a bruſh pencil dipt in water ſhould be paſſed over the whole, to ſmooth it and take away any lumps or inequalities that may have been formed: and when it is dry, the parts which admit of it ſhould be again bruſhed over till they be perfectly even. The work ſhould then be repaired, by freeing all the cavities and hollow parts from the priming, which may choak them, or injure the relief of the carving: after which a water poliſh ſhould be given to the parts deſigned to be burniſhed, by rubbing them gently with a fine linen rag moiſtened with water. The work being thus prepared, when it is to be gilt, dilute the compoſition of bole, &c. with warm ſize mix'd with two thirds of water; and with a bruſh ſpread it over the whole of the work, and then ſuffer it to dry; and go over it again with the mixture, in the ſame manner, at leaſt once more. After the laſt coat, rub it in the parts to be burniſhed with a ſoft cloth, till it be perfectly even. Some add a little vermillion to the gilding ſize, and others colour the work, if carved, before it be laid on, with yellow and the glover's ſize; to which a little vermillion, or red lead, ſhould be added. This laſt method is to give the appearance

of gilding to the deeper and obſcure parts of the carving, where the gold cannot, or is not thought neceſſary to be laid on. But this practice is at preſent much diſuſed; and inſtead of it ſuch parts of the work are coloured after the gilding; which treatment is called *matting*. The work being thus properly prepared, ſet it in a poſition almoſt perpendicular, but declining a little from you: and having the gilding ſize, place all the neceſſary inſtruments above deſcribed ready, as alſo a baſon of clean water ready at hand: wet then the uppermoſt part of the work, by means of a large camel's hair pencil dipped in the water; and then lay on the gold upon the part ſo wet, in the manner above directed for the gilding in oil, till it be completely covered, or become too dry to take the gold. Proceed afterwards to wet the next part of the work, or the ſame over again if neceſſary, and gild it as the firſt; repeating the ſame method till the whole be finiſhed. Some wet the work with brandy, or ſpirit of wine, inſtead of water; but I do not conceive any advantage can ariſe from it, that may not be equally obtained by a judicious uſe of water. This manner is moreover much more troubleſome and difficult, as well as expenſive. For only a ſmall part muſt be wet at one time, and the gold laid inſtantly upon it, or the brandy or ſpirits will fly off, and leave the ground too dry to take the gold. The work being thus gone over with the gilding, muſt be then examined; and ſuch parts as require it repaired, by wetting them with the camel's hair pencil, and covering them with the gold; but as little as poſſible of the perfect part of the gilding ſhould be wet, as the gold is very apt to turn black in this ſtate. When the repaired part alſo is dry, the work may be matted, if it require it; that is, the hollow parts muſt be covered with a colour the neareſt in appearance to gold. For this purpoſe ſome recommend read lead, with a little vermillion ground up with the white of an egg: but I think yellow oker, or Dutch pink, with red lead, would better anſwer the end: or the *terra di Sienna* very ſlightly burnt or mixed with a little red lead

would have a much better effect; and be more durable than any other mixture so near the colour of gold in shade. Isinglass size will likewise equally well supply the place of the whites of eggs in the composition for matting. The work being thus gilt, it must remain about twenty four hours; and then the parts of it that are designed to be burnished, must be polished with the dog's tooth, or with the burnishers of agate or flint made for this purpose. But it should be previously tried, whether it be of the proper temper as to dryness. For though twenty-four hours be the most general space of time, in which it becomes fit, yet the difference of season, or the degree of wet given to the work, makes the drying irregular, with regard to any fixed period. The way of distinguishing the fitness of the work to take the burnish, is to try two or three particular parts at a distance from each other; which, if they take the polish in a kindly manner, the whole may be concluded fit. But if the gold peel off, or be disordered by the rubbing, the work must be deemed not yet dry enough: and if the gold abide well the rubbing, and yet receives the polish slowly, it is a proof of its being too dry; which should be always prevented, by watching the proper time. For the work, when too dry, both requires much more labour to burnish it, and fails at last of taking so fine a polish.

*Of japanners gilding.*] The japanners gilding is performed by means of gold powder, or imitations of it, cemented to the ground by a kind of gold size much of the nature of drying oil: for the making which, there are various recipes followed by different persons. I shall, however, only give one of the more compound, that is much approved; and another very simple, but which, nevertheless, is equally good for the purpose with the most elaborate. The more compound gold size may be thus made.—"Take of gum animi and asphaltum each one ounce, of read lead, litharge of gold and umbre, each one ounce and a half. Reduce the grosser ingredients to a fine powder; and having mix'd them, put them, together with a pound of linseed oil, into a pro-

per veſſel, and boil them gently; conſtantly ſtirring them, with a ſtick or tobacco-pipe, till the whole appear to be incorporated. Continue the boiling, frequently ſtirring them, till, on taking out a ſmall quantity, it appear thick like tar, as it grows cold. Strain the mixture then through flannel; and keep it carefully ſtopt up in a bottle having a wide mouth, for uſe. But when it is wanted, it muſt be ground with as much vermillion, as will give it an opake body; and at the ſame time diluted with oil of turpentine, ſo as to render it of a conſiſtence proper for working freely with the pencil." ——The aſphaltum does not, I conceive, contribute to the intention of gold ſize: and the litharge of gold and read lead, are both the ſame thing, with reſpect to this purpoſe, under different names: and neither they nor the umbre neceſſary, but clogging ingredients to the compoſition. This gold ſize may therefore be equally well, or perhaps better prepared, in the following manner—"Take of linſeed oil one pound, and of gum animi four ounces. Set the oil to boil in a proper veſſel; and then add the gum animi gradually in powder; ſtirring each quantity about in the oil, till it appear to be diſſolved; and then putting in another, till the whole become mixed with the oil. Let the mixture continue to boil, till on taking a ſmall quantity out, it appear of a thicker conſiſtence than tar: and then ſtrain the whole thro' a coarſe cloth, and keep it for uſe. But it muſt, when applied, be mixed with vermillion and oil of turpentine, in the manner directed for the foregoing."—This gold ſize may be uſed on metals, wood, or any other ground whatever. But before I enter on the particular manner of gilding with it, the preparation of the true and counterfeit gold powders are neceſſary to be ſhown. The true gold powder may be well and eaſily made by the following method.—— "Take any quantity of leaf gold; and grind it with virgin honey, on a ſtone, till the texture of the leaves be perfectly broken; and their parts divided to the minuteſt degree. Then take the mixture of gold and honey from off the ſtone, and put it into a china or other

ſuch baſon, with water; and ſtir it well about, that the honey may be melted; and the gold by that means freed from it. Let the baſon afterwards ſtand at reſt, till the gold be ſubſided; and when it is ſo, pour off the water from it; and add freſh quantities till the honey be entirely waſhed away; after which the gold may be put on paper, and dried for uſe."——A gold powder of a more intenſe yellow colour, brighter than this, may be made by a precipitation from gold diſſolved in *aqua regia*, by means of either green or Roman vitriol, in this manner.——"Take a ſolution of gold in *aqua regia;* and add to it gradually, a ſolution of green vitriol or copperas in water, till it appear that no further precipitation of the gold be made, on adding a freſh quantity. The ſolution of the copperas may be made, by putting one drachm of it powdered into an ounce of water, and ſhaking them till the whole appear to be diſſolved. After which the ſolution muſt ſtand; and the clear part be poured off from the ſediment, if any be found. The fluid muſt be poured off from the precipitated gold, as ſoon as it is perfectly ſubſided: and the precipitation muſt be well waſhed, by pouring on it ſeveral ſucceſſive quantities of water. Roman or blue vitriol may be employed for this purpoſe inſtead of the green, but it is ſomewhat dearer, and has no advantage over the other. The gold precipitate thus obtained is very bright and ſhining. A ſimilar kind may be prepared, by putting flat bars or plates of copper into the ſolution of the gold in *aqua regia:* but the precipitate is of a brown colour, without any luſtre or ſhining appearance."—The German gold powder, which is the kind moſt generally uſed, and, where it is well ſecured with varniſh, will equally anſwer the end in this kind of gilding with the genuine, may be prepared from the ſort of leaf gold, called the *Dutch gold*, exactly in the ſame manner as the true. The *aurum Moſaicum*, which is tin coloured, and rendered of a flaky or pulverine texture, by a chemical proceſs, ſo as greatly to reſemble gold powder, may be likewiſe uſed in this kind of gilding; and prepared in

the following manner—"Take of tin one pound, of flowers of sulphur seven ounces, and of *sal Ammoniacus* and purified quicksilver each half a pound. Melt the tin; and add the quicksilver to it in that state: and when the mixture is become cold, powder it, and grind it with the *sal Ammoniacus* and sulphur, till the whole be thoroughly commixt. Calcine them then in a mattrass; and the other ingredients subliming, the tin will be converted into the *aurum Mosaicum;* and will be found in the bottom of the glass like a mass of bright flasky gold powder: but if any black or discoloured parts appear in it, they must be carefully pick'd or cut out."—The *sal Ammoniacus* employed ought to be perfectly white and clean; and care should be taken that the quicksilver be not such as is unadulterate with lead; which may be known, by putting a small quantity in a crucible into the fire, and observing, when it is taken out, whether it be wholly sublimed away, or have left any lead behind it. The calcination may be best performed in a coated glass body, hung in the naked fire; and the body should be of a long figure, that the other ingredients may rise so as to leave the coloured tin clear of them. The quicksilver, tho' it be formed into cinnabar along with the sulphur, need not be wasted; but may be revived by distilling it with the addition of quick lime; for which a very cheap and commodious method and apparatus may be found in a late treatise on practical chemistry, intitled, *The Elaboratory laid open. &c.* There are some other coarser powders in imitation of gold, which are formed of precipitations of copper. But as they are seldom used now for gilding, I shall defer showing the manner of preparing them, till I come to speak of bronzing, where they more properly occur. Besides these powders, the genuine leaf or Dutch gold may be used with the japanners gold size, where a more shining and glossy effect is desired in the gilding. But in that kind of gilding which is intended to be varnished over, or to be mixed with other japan work or paintings in varnish, the powders are most frequently employed. The gilding with japanners gold

size may be practised on almost any substance whatever, whether wood, metal, leather, or paper: and there is no further preparation of the work necessary to its being gilt, than the having the surface even and perfectly clean. The manner of using the jappanners size, is this. Put then a proper quantity of it, prepared as above directed, and mixed with the due proportion of oil of turpentine and vermillion, into a small gally-pot, or one of those tin vessels above described, for containing the colours when used for in painting varnish. Then either spread it with a brush over the work, where the whole surface is to be gilt; or draw with it, by means of a pencil, the proper figure desired, avoiding carefully to let it touch any other parts. Suffer it afterwards to rest till it be fit to receive the gold: which must be distinguished by the finger, in the same manner as with the fat oil; the having a proper clammineſs or sticky quality, without being so fluid as to take to the finger, being alike the criteriton in both cases. Being found of a proper dryness, when the gold powders are to be used, a piece of the soft leather, called *washleather*, wrapt round the fore finger, must be dipt in the powder, and then rubbed very lightly over the sized work; or, what is much better, the powder may be spread by a soft camel's hair pencil. The whole being covered, it must be left to dry; and the loose powder may then be cleared away from the gilded part, and collected, by means of a soft camel's hair brush. When leaf gold is used, the method of sizing must be the same as for the powders: but the point of due dryness is very nice and delicate in these cases. For the leaves must be laid on while the matter is in a due state, otherwise the whole of what is done must be sized and gilt over again. When more gold size is mixed up with the oil of turpentine and vermillion, than can be used at one time, it may be kept, by immersing it under water till it be again wanted: which is indeed a general method of preserving all kind of paint, or other such compositions as contain oily substances.

*Of gilding paper, vellum or parchment.*] There are

a variety of methods uſed for gilding paper, according to the ſeveral ends it is deſigned to anſwer; but for the moſt part ſize, properly ſo called, and gum water, are uſed as the cements; and the powders are more generally employed than the leaf gold. As I have given the preparation of theſe ſeveral ſubſtances before, it is needleſs to repeat them here; and I ſhall therefore only point out thoſe circumſtances in the manner of their uſe, which are peculiar to the application of them to this purpoſe.

*Of the gildings on paper proper to be uſed along with paintings in water colours, or freſco.*] The gilding proper to be uſed with water colours may be either with the leaf gold, or powder; which laſt, when mixed with the proper vehicle, is called *ſhell gold*. The leaf gold is neceſſary in all caſes, where a metalline and ſhining appearance is wanted: and it may be laid on the deſigned ground, by means either of gum water, or iſinglaſs ſize. The gum water or ſize ſhould be of the weaker kind, and not laid too freely on the ground; and proper time ſhould likewiſe be given for it to dry: the judgment on which muſt be formed, in this caſe, as in the other kinds of gilding, by touching with the finger. The management of the gold alſo is much the ſame in this as in the former: and where a poliſhed appearance is wanting, the dog's tooth or other kind of burniſher may be uſed. In the gilding larger ſurfaces, it will be found advantageous to colour the ground with the gall ſtone: and where colours are to be laid on the gilding, the bruſhing the gold over with the gall of any beaſt will make it take them in a much more kindly manner. When the gold powders are uſed along with paintings in water colours, it is previouſly formed into *ſhell gold*, (as it is called, from its being uſually put into muſcle ſhells, in the ſame manner as the colours.) This ſhell gold is prepared, by tempering the gold powder with very weak gum water; to which a little ſoap-ſuds may be put, to make the gold work more eaſily and freely. The preparation of the gold powders is before given, p. 12, and that of the gum

water, may be thus prepared.——"Take three quarters of an ounce of gum Arabic, and a quarter of an ounce of gum Senegal. Powder them, and then tie them up in a linen rag; leaving so much unfilled room in the bag, as to admit its being flattened by the pressure of the hand. Having squeezed the bag till it be flat, put it into a quart of hot water; and there let it continue, moving it sometimes about, and stirring the water for about twenty-four hours. The gums will then be dissolved; and the bag must be taken out. The fluid being divided into two parts, to one half of it add a quarter of an ounce of white sugar-candy powdered, and keep the other in its pure state. By this means, a strong and weak gum water, each proper for their particular purposes, will be obtained."

*Of the gilding proper for the coloured paper for binding books, and other such purposes.*] This kind of gilding is performed in much the same manner as that for mixing with paintings in water colours; except with regard to the following particulars. First, in this case, the gilding being intended generally to form some figure or design, the gum water or size, instead of being laid on with a brush or pencil, is most generally conveyed to the ground by means of a wooden plate, or print, and most expeditiously by an engraved roller, which make an impression of the figure or design intended. Secondly, as the rising of the gold from the surface of the ground is no disadvantage in this kind of gilding, as it is in that mixed with paintings, the gum water or size may be much stronger; which will contribute both to bind the gold firmer, and to give it a sort of embossed appearance, that improves the effect. In this kind of gilding, the japanners gold size may be also commodiously employed. For, as the paper must be moistened before it be printed, there is no inconvenience liable to happen from the running of the gold size thus used. Where the embossed appearance is wanted in the greatest degree, the gold size should indeed always be used: and in this case should be thickened with yellow oker, mixed with as much read lead, as the proper working

of the print will admit. The wooden plates or prints uſed for gilding in this manner, are worked by the hand, and are to be charged with the gum water or ſize, of whatever kind it be, by letting it gently and evenly down on a cuſhion on which the gum water or ſize has been copiouſly ſpread by means of a proper bruſh; and then preſſing it on the paper prepared by moiſtening it with water, and laid horizontally with ſome ſheets of other paper under it. Where the rolling print is employed, the gum water or ſize muſt be laid on it by a proper bruſh, immediately out of the pot or veſſel which contains it: but too copious an uſe muſt be avoided, for fear of ſpreading it beyond the lines of the deſign or pattern. The ſubſequent management of the gold, whether leaf or powder, muſt be the ſame as in the foregoing kinds of gilding. It rarely anſwers to uſe the leaf gold in this kind of painting, nor even the true gold powder: but the German powder, or that formed of the leaves called *Dutch gold*, is moſtly employed, and anſwers well enough the purpoſe. The manufactures of the gilt and marbled papers have not been ſo much cultivated in our own country, as it were to be wiſhed, ſince very great ſums have been always annually paid, both to Germany and Genoa, on this account. The improvement of this manufacture is, therefore, a very fit object of attention to that moſt laudable ſociety for the eſtabliſhment and encouragement of uſeful arts, who have offered premiums to thoſe who would give proofs of their endeavours or ſucceſs in parallel inſtances. This ſociety has accordingly given lately a bounty to Mr. Moor, of New-ſtreet, who has eſtabliſhed a manufacture of gilt and flowered paper; which exceeds greatly the foreign in beauty, and is ſold at a cheaper rate than that can be afforded, even when the duty on importation is not paid.

*Of gilding proper for letters of gold on paper, and the embelliſhment of manuſcripts.*] The moſt eaſy and neat method of forming letters of gold on paper, and for ornaments of writings, is, by the *gold ammoniac*, as it was formerly called: the method of managing which is

as follows.—"Take gum Ammoniacum, and powder it, and then dissolve it in water previously impregnated with a little gum Arabic, and some juice of garlic. The gum Ammoniacum will not dissolve in water, so as to form a transparent fluid, but produces a milky appearance; from whence the mixture is called in medicine the *lac Ammoniacum*. With the lac Ammoniacum thus prepared, draw with a pencil, or write with a pen on paper, or vellum, the intended figure or letters of the gilding. Suffer the paper to dry; and then, or any time afterwards, breathe on it till it be moistened; and immediately lay leaves of gold, or parts of leaves cut in the most advantageous manner to save the gold, over the parts drawn or written upon with the lac Ammoniacum; and press them gently to the paper with a ball of cotton or soft leather. When the paper becomes dry, which a short time or gentle heat will soon effect, brush off, with a soft pencil, or rub off by a fine linen rag, the redundant gold which covered the parts between the lines of the drawing or writing; and the finest hair strokes of the pencil or pen, as well as the broader, will appear perfectly gilt."—It is usual to see in old manuscripts, that are highly ornamented, letters of gold which rise considerably from the surface of the paper or parchment containing them, in the manner of embossed work; and of these some are less shining, and others have a very high polish. The method of producing these letters is of two kinds; the one by friction on a proper body with a solid piece of gold: the other by leaf gold. The method of making these letters by means of solid gold is as follows.——"Take crystal, and reduce it to powder. Temper it then with strong gum water, till it be of the consistence of paste; and with this, form the letters. When they are dry, rub them with a piece of gold of good colour, as in the manner of polishing; and the letters will appear as if gilt with burnished gold."—Kunckel has, in his fifty curious experiments, given this recipe: but omitted to take the least notice of the manner how these letters are to be formed; though the most difficult circumstance in

the production of them. It may, however, be done by means of a ſtamp in this manner. Let the emboſſed figure, either of the ſeparate letters or of the whole words be cut in ſteel; and, when the ſtamps are to be uſed, anoint each letter carefully with the end of a large feather dipped in oil; but not ſo wet as to leave drops in the hollows of the ſtamps. Fill theſe concave letters, in the ſtamps, with the above mixture of powdered cryſtal and gum water; and, wiping the other parts of them perfectly clean, place them then on the paper or vellum, laid over ſome ſheets of paper; taking care that the letters may be in the exact poſition where they ought to lie: ſtrike then the ſtamp in a perpendicular direction, but not too forcibly; and take it off in the ſame direction. The letters will be left in their proper places by this means, and will have the ſame proportions as their archetypes in the ſtamps. Where leaf gold is uſed for making emboſſed letters in manuſcripts, the above compoſition cannot be uſed; but there are ſeveral others which will very well ſupply its place: of which the following has been given as very excellent.—"Take the whites of eggs, and beat them to an oily conſiſtence; then take as much vermillion as will be required to thicken the whites of the eggs to the conſiſtence of paſte. Form the letters of this paſte, by means of the ſtamps, in the manner before directed; and when they are become dry, moiſten them by a ſmall pencil with ſtrong gum water; obſerving not to let it run beyond the bounds of the letters. When the gum water is of a proper dryneſs, which muſt be judged of by the rule before given, cover the letters with leaf gold, and preſs it cloſe to every part of them, by cotton or ſoft leather. After the gilding is dry, it may be poliſhed by the dog's tooth, or the other proper burniſhers."

*Of gilding proper for the edges of books and paper.*] There are ſeveral various methods with reſpect to the cement uſed, by which the edges of books or paper may be gilt: as ſtrong gum water, or iſinglaſs ſize, or glovers ſize, may be employed: but as the gum water, and weaker ſizes are apt to run beyond the edge, and

ſtick the leaves together, iſinglaſs melted with the addition of ſome common proof ſpirit of wine, and a ſixth part of honey or ſugar candy is greatly preferable: but a third of bole ammoniac well powdered muſt be added. The following compoſition has been likewiſe approved of for this purpoſe.——"Take bole ammoniac and ſugar candy well powdered, each equal parts: mix them with the whites of eggs beaten to an oily conſiſtence; and the cement will be fit for uſe."—In order to the uſing any of theſe cements, the paper, whether it be in quires or books, ſhould be well cut, and poliſhed on the edges to be gilt; and then ſtrongly ſcrewed down by a preſs: in which ſtate, it is to be bruſhed over, firſt with a little of the cement without the ſugar-candy or the bole; and when that is dry, either with the cement above given, or any other ſolution of gum or ſize, with the proper proportion of the bole: after which it may be ſuffered to dry; and then water poliſhed, by rubbing it with a fine linen rag ſlightly moiſtened. It is then in a ſtate fit for receiving the gold; only it muſt be again gently moiſtened at that time: and the leaves may then be laid on, being cut according to the breadth they are to cover, and preſſed cloſely down by a cotton ball: and after the gilding is thoroughly dry and firm, it may be poliſhed in the manner of the foregoing kinds.

*Of gilding leather.*] Leather may be gilded for common occaſions by all the ſame methods which have been given for gilding paper or velum; except, that where the gold ſize is uſed, there is no occaſion to wet the leather, to prevent the running of the oil out of the bounds. Either leaf gold or the powders may therefore be employed as well for leather as paper. But, unleſs, in ſome fine work, or for very particular purpoſes, the German gold powder would anſwer as well as the true gold. It is needleſs conſequently to repeat here the methods above ſhown with reſpect to the gilding paper for covers to books, &c. which equally well ſuit for this purpoſe in general: but as there is a manner of gilding leather peculiar to the book-binders,

it is requiſite to explain it. The method of gilding uſed by the book-binder, is to have the letters or compartments, ſcrolls, or other ornaments, cut in ſteel ſtamps; not by ſinking, as in moſt other caſes, but by the projection of the figure from the ground. Theſe ſtamps are made hot; and leaves of gold being laid on the parts accommodated to the pattern or deſign of the gilding, the hot ſtamps are preſſed ſtrongly on the gold and leather; and bind the gold to it in the hollows formed by the ſtamp: the other redundant part of the gold being afterwards bruſhed or rubbed off. The manner practiſed by the profeſſed leather gilders, for the making hangings for rooms, ſkreens, &c. is not properly *gilding*, but *laquering*, being done by means of leaf ſilver, coloured by a yellow varniſh, on the ſame principle with the laquered frames of pictures, &c. which were formerly in uſe. It is an important manufacture, as the leather ornamented in this manner, not only admits of great variety of deſigns in embroſſed work, reſembling either gilding or ſilver; but alſo of the addition of paintings of almoſt every ſort. The manner of performing this kind of leather gilding is as follows. The ſkins are firſt procured in a dry ſtate, after the common dreſſing and tanning. Thoſe moſt proper for this purpoſe, are ſuch as are of a firm cloſe texture; on which account, calf, or goat ſkins are preferable to ſheep. But in that condition they are too hard and ſtiff for gilding in this way. In order therefore to ſoften them, they are firſt put for ſome hours in a tub of water, where they are, during ſuch time, to be frequently ſtirred about with a ſtrong ſtick. They are then taken out; and, being held by one corner, beaten againſt a flat ſtone. They are next made ſmooth, by ſpreading them on the ſtone, and rubbing them ſtrongly over by an iron inſtrument reſembling a blade, but with the lower edge formed round, and the upper edge ſet in a wooden handle, paſſing horizontally the whole length of the blade. This inſtrument the workman ſlides on the ſurface of the ſkin as it lies on the ſtone, at the ſame time preſſing and lean-

ing on it with all his weight. When one of the skins is finished, another is laid over it, and treated in the same manner; and the others over that. The skins being thus prepared, are joined together, to form pieces of the size required for any particular purpose. In order to their joining properly, they are cut into a square, or rather oblong square form. To which end, a ruler or square is used, or the skins are placed on a table or block, corresponding in size and figure to a wooden print of the kind we shall have occasion to speak of below, and as much of the skin is taken off, as leaves it of the form and dimensions of the table or block. Any defective parts, or holes in the skin, are then to be made good; which is done by paring away with a penknife, half the thickness of the skin for some little space round the hole, or defective part; putting a patch, or correspondent piece of the same kind of skin over it. This patch, or piece, is to have a margin pared to have the thickness, to suit the pared part of the skin; and is then to be fixed in its place, by means of size made of parchment, or glovers cuttings, in the manner described before. After the skins are thus prepared, the next operation is the sizing them, which is done by means of a kind of soft glue, or stiff size, that answers to the gold size, used in other kinds of gilding or silvering, prepared from parchment, or glovers cuttings. This is, in fact, the same with that directed to be used for joining the pieces; only it must be reduced by longer boiling to a thicker consistence, which should be that of a very stiff jelly. To size a skin or piece, the workman takes a piece of the size of the bigness of a nut; which, however, he does not use whole, but cuts into two parts. With one of these parts, he rubs all the skin, or piece of leather, strongly; and when it is, by this means, spread over the whole surface of the leather, he rubs it with the palm of his hand to disperse it more equally, and uniformly over every part. To the effecting this end, the heat of the hand contributes as well as the motion: as it melts the size to a certain degree of fluidity, and ren-

ders it consequently more capable of being diffused over the whole surface. The workman then leaves the skin for some time to dry, and afterwards spreads the other part of the size on it, in the same manner as the first; which finishes the operation of sizing. It is necessary to allow some space of time betwixt the laying on the two parts of the size. For if the whole was laid on together; or the first part before the other was dry to a certain degree, the whole would dissolve, and be forced forwards before the hand, instead of being spread by it. In the prosecution of this business, the workman therefore, as soon as he has spread the first part of the size, takes another skin, and treats it in the same manner: which filling up the interval of time, proper for drying the first, he returns then to that, and puts on the other parts of the size, and by this alternative treatment of them, employs the whole of his time, without any loss, by waiting till either be dry. The side of the skin on which the hair grew, or what is called the *grain* of the leather, is always chosen for receiving the size and silver. This is necessary to be observed: because that side is evener, and of a closer texture than the other. The skins, being thus sized, are ready for receiving the leaves of silver: which are thus laid on. The workman, who silvers them, stands before a table; on which he spreads two skins before they are dry after the sizing. On the same table, on the right hand, he puts also a large book of leaf silver on a board, which near one end of it has a peg sufficiently long to raise it in such manner, as to make it slope like a writing desk. The book being thus placed, he takes out one by one the leaves of silver, and lays them on the skin previously sized as above. This he does by means of a small pair of pincers, formed by two little rods of wood fastened together at one end, and glued to a small piece of wood cut into the form of a triangle, intended to keep the ends of the two rods at a distance from each other; and to make them answer the purpose, when pressed by the fingers, of taking hold of the leaves of silver. On the side of the piece

in which the rods are joined to form the pincers, there is put a kind of tuft, or small brush, of an irregular form, made of foxes, or any other kind of soft hair. With these pincers, the workman takes hold of one of the leaves in the book, and puts it on a piece of cartoon, larger than the leaf, of a figure nearly square; and which has the corners of the end, that is to be placed in the hand of the workman, bent. This piece of cartoon is called a pallet. The workman takes it in his left hand, and, having put on it a leaf of silver, he turns it downward; and lets the leaf fall on the skin, spreading it as much as he can, and bringing, as near as possible, the sides of it, to be parallel to those of the square of leather, or skin. If it happen, that any part of it gets double, or is not duly spread, he sets it right; raises it sometimes, and puts it in its place, or rubs it gently with the kind of brush, or hair pencil which is at the end of the pincers. But most generally, the workman only lets the leaf fall in its place, spread out on the surface of the leather, without either touching or pressing it; except in the case we shall mention below. After he has done with this leaf, he lays a new one in the same line, and continues the same till such line be complete. He then begins close to the edge of this row of leaves, and forms another in the same manner; and goes on thus, till the whole skin be entirely covered with the leaf silver. This work is very easily and readily performed; as the leaves which are of a square form, are put on a plain surface, which is also rectangular. The skin being thus covered with the silver, the workman, takes a fox's tail, made into the form of a ball at the end, and uses it to settle the leaves, by pressing and striking them, to make them adhere to the size, and adopt themselves exactly to the places they are to cover. He afterwards rubs the whole surface gently with the tail, without striking, which is done to take off the loose and redundant parts of the silver, and at the same time to move them to those places of the surface, where there was before any defect of the

silver; and where, consequently, the size being bare, these will now take. The rest of the loose silver is brushed forwards to the end of the table, where a bag, or linen cloth is placed to receive it.

The skins, when they are thus silvered, are hung to dry on cords, fixed by the ends to opposite walls, at such height as to suspend the skins out of the way of the workman. To hang them on these cords, a kind of cross is used, formed of a strong stick, with a shorter piece of the same fixed crosswise at the end of it; over which the skin being hung without any doubling and with the silvered side outwards, it is conveyed and transferred to the cord in the same state. The skins are to dry in this condition, a longer or shorter time, according to the season and the weather. In summer, four or five hours is sufficient; or those skins which have been silvered in the morning, may remain till the evening, and those in the evening, till next morning. But in winter a longer time is required, according to the state of the weather. There is no occasion, nevertheless, to wait till they be entirely dry. As they may be put in any back yard or garden exposed to the wind, and the heat of the sun. For this purpose they should be put over two boards joined together, where they must be kept stretched out by means of some nails. But in this case, the silvered side must be next the boards, in order to prevent any dirt from falling on it, and sticking to the size, which would hinder their taking well the burnish, that will be mentioned below. The heat, and the dryness of the air, must determine, also, the time of their hanging in this state: but experience alone can teach how to judge of this point. It is proper the skin should be free from moisture; but yet, they should retain all their softness: in summer this will happen in a few hours, and they will be then in a condition to be burnished. The burnisher which is used for this purpose, is a flint, of which various figures may be allowed, and which must be mounted differently with a handle, according to the difference of the figure. A cylindrical form is often chosen, in which case, one

of the ends ſhould be of a round figure, of about an inch and a half diameter, and have the ſurface extremely ſmooth; as the poliſhing is performed with this ſurface. The flint is fixed in the middle of a piece of wood of a foot length, the whole of which length is neceſſary to its ſerving as a handle; or the workman takes hold of it at each end, with each of his hands, thoſe parts being roundiſh, and the middle being left of a greater thickneſs, in order to admit of a hole of a proper depth for receiving the flint, ſo as to keep it quite firm and ſteady. All the art required in the manner of burniſhing is, to rub the leaf ſilver ſtrongly; for which purpoſe, the workman applies both hands to to the burniſher, dwelling longer on thoſe parts which appear moſt dull. In order to perform this operation, the ſkin is put and ſpread even on a ſmooth ſtone of a requiſite ſize, placed on a table, where it may be ſo firm and ſteady, as to bear all the force of preſſure the workman can give in ſliding the burniſher backwards and forwards over every part of the ſkin. It would ſave a great deal of labour to employ, inſtead of this method of burniſhing, that uſed by the poliſhers of glaſs, and alſo by the card makers. This method conſiſts in fixing the burniſher at the end of a ſtrong crooked ſtick, of which, the other end is faſtened to the ceiling. The ſtick being ſo diſpoſed, as to act as a ſpring, of which the force bears on the ſkin, it exempts the workman from this part of the labour, and leaves him only that of ſliding the burniſhers along the ſkin, in the directions the poliſhing requires. The objections to this method are, that ſome parts of the ſkin require a greater preſſure than others, and that ſometimes dirt ſticking to the ſize, which paſſes through the joining of the ſilver, will ſcratch the work, if the workman in going along did not ſee and remove it, which he cannot ſo well do in uſing the ſpring burniſher. But certainly, theſe inconveniencies have obvious remedies, when they are underſtood. The uſing the ſpring burniſher for the greateſt part of the work, does not prevent taking the aid of the common one for

finiſhing, if any parts, that appear imperfectly poliſhed, ſhall render it neceſſary; and the workman may well afford the trouble of examining the ſkin, and cleanſing it thoroughly, by the labour he will ſave in this way; or, perhaps, it is always beſt to do this office, before any kind of poliſhing be begun, rather than to leave it to be done during the poliſhing. In ſome manufactures, the burniſhing is performed, by paſſing the ſilvered ſkins betwixt two cylindrical rollers of ſteel, with poliſhed faces. If this be well executed, it muſt give a conſiderable brilliance to the ſilver, and take away all thoſe warpings and inequalities in the leather, which tend to render the ſilvered ſurface leſs equal and ſhining. The ſkins or leather, being thus ſilvered and burniſhed, are now prepared to receive the yellow laquer or varniſh, which gives the appearance of gilding. The perfection of this work depends, obviouſly, in a great degree, on the colour, and other qualities of the compoſition uſed as ſuch varniſh: for which different artiſts in this way have different recipes; each pretending, in general, that his own is beſt, and making conſequently a ſecret of it. The following is, however, at leaſt equal to any hitherto uſed; and may be prepared without any difficulty, except ſome little nicety in the boiling.——"Take of fine white reſin four pounds and a half; of common reſin the ſame quantity; of gum ſandarac two pounds and a half, and of aloes two pounds. Mix them together, after having bruiſed thoſe which are in great pieces; and put them into an earthen pot, over a good fire made of charcoal, or over any other fire where there is no flame. Melt all the ingredients in this manner, ſtirring them well with a ſpatula, that they may be throughly mixed together, and be prevented alſo from ſticking to the bottom of the pot. When they are perfectly melted and mixed, add gradually to them, ſeven pints of linſeed oil, and ſtir the whole well together with the ſpatula. Make the whole boil, ſtirring it all the time, to prevent a kind of ſediment, that will form, from ſticking to the bottom of the veſſel. When the var-

niſh is almoſt ſufficiently boiled, add gradually, half an ounce of litharge, or half an ounce of read lead; and when they are diſſolved, paſs the varniſh through a linen cloth, or flannel bag."

The time of boiling ſuch a quantity of varniſh, may be in general about ſeven or eight hours. But as the force of the heat, and other circumſtances, may vary, it does not permit of any preciſe rule. The means of judging of this, is by taking a little quantity out of the pot, with a ſilver ſpoon, or other ſuch inſtrument, and touching it with the finger; when, if the varniſh appear, on cooling, of the conſiſtence of a thick ſyrup, become ſoon after ropy, and then drying, glue the fingers together, and give a ſhining appearance; it may be concluded, the time of boiling is ſufficient. But if theſe ſigns are found wanting, the contrary muſt be inferred; and the boiling muſt be continued till they do ariſe. When the quantity of ingredients is diminiſhed, the time of boiling may be alſo contracted. A pint of oil, and a correſpondent proportion of fine reſin and aloes, has produced a varniſh perfectly good in an hour and a half. In this proceſs, it is very neceſſary to have a pot, that will not be half filled with all the ingredients; and alſo to guard with the greateſt caution againſt any flame coming near the top of the pot, or the vapour, which riſes from it during the boiling. For it is of ſo combuſtible a nature, it would immediately take fire; and the ingredients themſelves would burn in ſuch a manner, as would not only defeat the operation, but occaſion the hazard of other inconveniencies. The varniſh thus prepared, attains a brown appearance; but, when ſpread on ſilver, gives it a colour greatly ſimilar to that of gold. If, however, it ſhould not be found, after this proceeding, that the force of yellow was ſufficiently ſtrong, an addition of more aloes muſt be made before the boiling be diſcontinued. Care muſt be taken, nevertheleſs, in doing this, not to throw in a large lump at once; becauſe ſuch an effervescence is excited, in that caſe, as would endanger the varniſh riſing over the edge of the

veſſel, and producing a flame, that would inſtantly make the whole take fire. On the other hand, if the varniſh ſeem too ſtrong of the colour, ſandaric muſt be added with the ſame precaution, which increaſing the quantity of varniſh, will dilute the colour. The laying the laquer, or varniſh on the ſilvered leather, is performed in the open air: and ſhould be done in ſummer, when it is hot and dry. It is thus performed: The ſkins are again to be ſtretched and faſtened with nails to the ſame boards on which they were before fixed to complete the drying after the ſilvering: but with this difference, that the ſilvered ſide muſt be outwards. Eighty or twenty ſkins may be treated thus at the ſame time: there being two or three on each board. All the boards ſhould be then ranged on treſſels parallel to each other, in ſuch manner, that all, both of them and the ſkins, may be cloſe to each other. Every thing being thus prepared, the principal workman ſpreads ſome of the white of eggs over each ſkin. The uſe of this is to fill up ſmall inequalities in the ſurface of the ſkin; and to prevent the varniſh paſſing through the interſtices of the ſilver, and being abſorbed by the leather. Some omit this: and with advantage, if theſe inconveniencies could be avoided without it: as it renders the varniſh more apt to crack and peel off the ſilver. But where it is omitted, the varniſh ſhould be of a thicker conſiſtence; the ſurface of the leather of a firm denſe texture; and the leaves of ſilver of a greater thickneſs than the common. When the white of eggs is dry, the workman who lays on the varniſh ſets it on the table before him in a pot; being, as before directed, pretty near the conſiſtence of a thick ſyrup. He then dips the four fingers of one of his hands in the varniſh; and uſes them as a pencil to ſpread it on the ſkin. In doing this, he holds the fingers at a ſmall but equal diſtance from each other, and putting the ends of them on the ſkin near one of the edges of it; and he then moves his hands ſo, that each finger paints a kind of *S* with the varniſh, from one end of the ſkin to the other. He afterwards dips his fingers again in the varniſh, and repeats the ſame operation again on the

next part of the skin, till the whole be gone over in the same manner. This might be done with a pencil or proper brush: but the workman finds the using the fingers only, to be the readiest method for distributing the varnish equally over the skin. After the varnish is thus laid on the skin, it is to be spread: which is still done by the hand solely. The method is, to rub the flat of the open hand over every part of the skin on which the varnish has been put by the fingers, and by that means diffuse it evenly over every part. After this, it is to be immediately beaten by strokes of the palms of the hands, which are to be frequently repeated on every part in general, but in a greater degree on those places where the varnish appears to lie thicker than on the rest: and in doing this, both hands are, for dispatch, employed at the same time. When this operation is finished, the skins are still to be left on the boards where they were stretched and nailed; and those boards are, therefore, either continued till that time on the treffels where the varnish was put on the skin; or, if they be wanted for fresh skins, taken off, and fixed up against the wall of the place, or any other proper support. The time of drying depends of course on the heat of the sun and weather; but at a seasonable time does not exceed a few hours. It is to be known, as to each particular parcel of skins, by examining them with the finger. If on touching them, they be found free from any stickiness, or, in the style of workmen, tackiness, or that the finger makes no impression on the varnish, they may be concluded sufficiently dry; and the contrary, when they are found to be otherwise. This coat of varnish being dry, the skins are to be again put on the treffels as before, and another coat laid on exactly in the same manner as the first. In doing this, examination must be made, whether any of the skins appear stronger or weaker coloured than the others; in order that the defect may be now remedied, by making this coat thicker or thinner, as may appear necessary. When this coat is dry, the varnishing for producing the appearance of gilding is completed: and if it has been well performed,

the leather will have a very fine gold colour, with a conſiderable degree of poliſh or brightneſs. When there is an intention to have one part of the leather ſilver, and the other gold, a pattern is formed on the ſurface, by printing, calking, or ſtamping a deſign on the ſurface after the ſilvering. The ſkin is then to be varniſhed, as if the whole were intended to be gold; but after the laſt coat, inſtead of drying the varniſh, it is to be immediately taken off that part which is intended to be ſilver, according to the deſign printed or calked upon it, by a knife; with which the workman ſcrapes off all that he can without injuring the ſilver, and afterwards by a linen cloth, with which all that remains is endeavoured to be wiped or rubbed off. The ſkins, being thus ſilvered and varniſhed, are made the ground of various deſigns for emboſſed work and painting. The emboſſed work or relief is raiſed by means of printing with a rolling preſs, ſuch as is uſed for copper plates; but the deſign is here to be engraved on wood. The painting may be of any kind: but oil is principally uſed, as being durable and moſt eaſily performed. There is nothing more neceſſary in this caſe, than in painting on other grounds, except that, where varniſh or water is uſed, the ſurface be clean from any oily or greaſy matter.

*Of gilding of glaſs without annealing or burning.*] Glaſs may be gilt, by applying as a cement, any gold ſize, or other ſize, gum water or varniſh; and, when it is of a proper degree of dryneſs, laying on the gold, as in the other methods of gilding. The work may alſo be poliſhed afterwards in the ſame manner, if the burniſhed appearance be deſired: but where that is intended, it is proper to add bole ammoniac, chalk, or other ſuch ſubſtance, to the cement. When drinking-glaſſes are to be gilt, without burning, the cement ſhould be either ſome gold ſize formed of oil, or ſome kind of varniſh compounded of the gum reſins, that will not diſſolve in water; but require either ſpirit of wine or oil of turpentine for their ſolution. At preſent, nevertheleſs, this is not only neglected by thoſe who gild

drinking-glaſſes for ſale; but glaſſes gilded with gum arabic, or the ſizes which will diſſolve in water, are impoſed upon the public for the German glaſſes gilt with the annealed gold; and ſold at the dear rate under that pretence; though after they have been uſed for a very ſhort time, the gold peels and rubs off in ſpots when the glaſſes are cleaned; and renders them very unſightly. As the glaſſes with gilt edges are at preſent much in faſhion, and the true kind are brought from Germany, or elſewhere, the incitement of the cultivating this branch of gilding here, would not be an unfit object of the premiums of the worthy ſociety for the encouragement of arts. Since for the doing this work in perfection, there is nothing more wanting, than that dexterity of the manœuvre, which ariſes from a little practice in matters of this kind.

*Of ſilvering.*] Silvering may be practiſed on the ſame ſubſtances; and all by the ſame methods, either with leaf or powder, as we have before pointed out with regard to gilding; variation being made in a few circumſtances below mentioned. It is, nevertheleſs, but ſeldom uſed, notwithſtanding the effect would be very beautiful and proper in many caſes; and there is an extreme good reaſon for ſuch a neglect of it. This reaſon is, its tarniſhing in a very ſhort time; and acquiring frequently, beſides the general depravity of the whiteneſs, ſuch ſpots of various colours, as render it very unſightly: and this tarniſh and ſpecking is not only the conſtant reſult of time, but will be often produced inſtantly by any extraordinary moiſture in the air, or dampneſs, as well as by the fumes and effluvia of many bodies which may happen to approach it. Wherever, therefore, ſilvering is admitted, a ſtrong varniſh ought to be put over it: and this even is not ſufficient wholly to ſecure it from this deſtructive conſequence. The varniſh muſt be ſome of the compoſitions of maſtic, ſanderac, the gums animi or copal, and white reſin; (the particular treatment of which in the forming varniſhes will be found in other parts of this work) for the other ſubſtances uſed for compounding varniſhes are too yellow. Some put a

coat of iſinglaſs ſize over the ſilver; but, beſides that the ſize itſelf injures the whiteneſs in time, by turning yellow, it preſerves the ſilver but in a ſmall degree. Experience has ſhown, in the caſe of the ſilvered leather, what the varniſh may be compoſed of, that anſwers beſt for this purpoſe, and the kind before given, p. 28, under that head, may be applied to other purpoſes. The methods of making the ſilver powders, is alſo the ſame as thoſe of gold, except with regard to one of the German powders, which is correſpondent both in its appearance and uſe, abating the difference of colour, to *aurum Moſaicum* or *muſivum*: whence it has been indeed, though improperly, called the *argentum muſivum*. The proceſs for this being, therefore, different from any before given, it is proper to inſert it fully, as follows: ——"Take of very pure tin one pound: put it into a crucible, and ſet it on a fire to melt: when it begins to run into fuſion, add to it an equal proportion of biſmuth or tin glaſs: and ſtir the mixture with an iron rod, or the ſmall end of a tobacco-pipe, till the whole be intirely melted, and incorporated. Take the crucible then from the fire; and, after the melted compoſition is become a little cooler, but while it is yet in a fluid ſtate, pour into it a pound of quickſilver gradually; ſtirring it in the mean time, that the mercury may be thoroughly conjoined with the other ingredients. When the whole is thus commixt, pour the maſs out of the crucible on the ſtone; where, as it cools, it will take the form of an amalgama or metalline paſte; which will be eaſily bruiſed into a flaſky powder; and is then fit for uſe."—This powder may be either tempered, in the manner of the ſhell gold, with gum water; or rubbed over a ground properly ſized, according to any of the methods above directed for gold powder; and it will take a very good poliſh from the dog's tooth or burniſhers, and hold its colour much better with a ſlight coat of varniſh over it, than any true ſilver powder or leaf. The ſizes for ſilvering ought not to be mixed, as in the caſe of gold, with yellow, or bole ammoniac: but with ſome white ſubſtance, whoſe effect may prevent

any small failures in the covering the ground with the silver from being seen, in the same manner as the yellow substances do the gold. This may be done with flake white, or white lead, when the sizes formed of oil are used: but whiting is the proper matter in the burnish size for silvering; or wherever the glover's or parchment size is used. Some recommend tobacco pipe clay in the place of whiting; and add a little lamp-black to give a silver like greyishness to the composition. Leather is silvered by those who have the manufactures of hangings, skreens, &c. though not so frequently with a view to the retaining its own colour, as to produce the imitation of gilding, of which the whole process is before given, p. 22. In some cases, nevertheless, the appearance of silver is retained; and it is therefore proper to take some notice of the manner of performing this work. The proceeding in silvering the leather, is to be in all respects the same, as when it is to have the appearance of gilding (of which the particular manner has been before shown under the article of gilding leather) till that part of the process where the varnish or laquer, which is to give the yellow colour, is to be laid on. Instead of this yellow varnish, a clear colourless one is to be substituted, where the appearance of silver is to be preserved: but this is necessary only, in order to prevent the tarnish and discolouring, which of course happens in a short time to silver exposed in a naked and undefended state to the air. The most common varnish used for this purpose, is only parchment size, prepared as above directed, p. 7, which is preferred to others, on account of its cheapness. This is made warm, in order to render it fluid, and then laid on with a spunge instead of a pencil or brush. There is no reason, however, as this kind of varnish is liable to suffer by moisture, and grow foul and discoloured, that better kinds, such as those of Martin, or others, which are used for *papier mache*, wood, &c. should not be employed here, provided they be colourless. The more hard and transparent, and the more they are of a refinous nature, the more brilliant and white, and the more durable will be

the silvery, and polished appearance of the silver leather. Some, instead of parchment size, use that made of isinglass, which may be prepared according to the method laid down, p. 7. This resists moisture, and will keep its colour and transparency, better than the other kinds of size: but all of them grow yellow and cloudy with time; especially if any damper moisture have access to them. Indeed silver secured even by the best varnish, will still in time take a tarnish, and lose its beauty: and therefore the giving the leaf silver on leather the appearance of gold, even tho' attended with some additional expence, is preferable in most cases. Leather silvered in this manner may be ornamented by printing in relief, and by painting, in the same manner as that representing gilding: though, on account of the want of durability, this is much seldomer practised. It is possible that some amalgama of quicksilver, or other composition, might be found that would have the resemblance of silver, and yet resist tarnishing: which would not only be a great improvement, by the furnishing a durable kind of silvering for leather, paper, &c. but also save part of the expence of leaf silver for a ground for gilded leather. This has been attempted in France with some success; but not to the degree of perfection wished for.

*Of bronzing.*] Bronzing is colouring, by metalline powders, platter, or other busts and figures, in order to make them appear as if cast of copper or other metals. This is sometimes done by means of cement, and sometimes without, in the instance of plaster figures: but the bronzing is more durable and secure when a cement is used. The gold powders, and the *aurum Mosaicum*, we have before given the preparation of, are frequently employed for this purpose; but the proper bronzing ought to be of a deeper and redder colour, more resembling copper; which effect may be produced by grinding a very small quantity of red lead with these powders; or the proper powder of copper may be used: and may be prepared as follows—— "Take filings of copper, or slips of copper-plates, and dissolve

them in any kind of *aquafortis* put into a glafs receiver, or other proper formed veffel. When the *aquafortis* is faturated with the copper, take out the flips of the plates; or, if filings were ufed, pour off the folution from what remains undiffolved, and put into it fmall bars of iron: which will precipitate the copper from the *aquafortis* in a powder of the proper appearance and colour of copper. Pour off the water then from the powder; and wafh it clean from the falts, by feveral fucceffive quantities of frefh water."—— Where the apearance of brafs is deſigned, the gold powders, or the *aurum Mofaicum*, may be mixed with a little of the powder called *argentum muſivum*; of which the preparation is above given. Where the appearance of filver is wanted, the *urgentum muſivum* is the beft and cheapeft method; particularly as it will hold its colour much longer than the true filver ufed either in leaf or powder. Where no cement is ufed in bronzing, the powder muft be rubbed on the fubject intended to be bronzed, by means of a piece of foft leather, or fine linen rag, till the whole furface be coloured. The former method of ufing a cement in bronzing was, to mix the powders with ſtrong gum water, or iſinglafs fize; and then with a brufh, or pencil, to lay them on the fubject.

But at preſent ſome uſe the japanners gold fize: and proceed in all reſpects in the ſame manner as in gilding with the powders in other caſes: for which ample directions have been before given. This is the beſt method hitherto practiſed. For the japanners gold fize binds the powders to the ground, without the leaſt hazard of peeling or falling off; which is liable to happen when the gum water or glover's or iſinglaſs fizes are uſed. Though, notwithſtanding the authority of the old practice for the contrary, even theſe cements will much better ſecure them when they are laid on the ground, and the powders rubbed over them, than when both are mixed together, and the effect, particularly of the *aurum Moſaicum*, will be much better in this way than the other. The gold fize ſhould be ſuffered, in this caſe, to approach much nearer to dryneſs, than is proper in

the case of gilding with leaf gold, as the powders would otherwise be rubbed amongst it in the laying them on. The fictitious silver powder, called the *argentum musivum*, may, as above-mentioned, be applied in the manner of bronze, by those whose caprice disposes them to silver figures or busts. But it is the only sort of silver powder that should be used in this way, for the reason above given: and all such kind of silvering is much better omitted. For the whiteness itself of plaister in figures or busts, and much more a glossy or shining whiteness, is injurious to their right effect; by its eluding the judgment of the eye, with respect to the proper form and proportion of the parts from the false and pointed reflections of the lights, and the too faint force of the shades. To remove which inconvenience it is probable was the first inducement to bronzing.

*Of japanning.*] By japanning is to be here understood the art of covering bodies by grounds of opake colours in varnish; which may be either afterwards decorated by paintings or gilding, or left in a plain state. This is not at present practised so frequently on chairs, tables, and other furniture of houses, except tea-waiters, as formerly. But the introduction of it for ornamenting coaches, snuff boxes, and skreens, in which there is a rivalship betwixt ourselves and the French, renders the cultivation and propagation of this art of great importance to commerce. I shall therefore be more explicit in showing the methods both now and and formerly in use; with the application of each to the several purposes to which they are best adapted; and point out at the same time several very material improvements, that are at present only enjoyed by particular persons; or not at all hitherto brought into practice. The substances which admit of being japanned are almost every kind that are dry and rigid, or not too flexible; as wood, metals, leather, and paper prepared. Wood and metals do not require any other preparation, but to have their surfaces perfectly even and clean. But leather should be securely strained

either on frames or on boards; as its bending or forming folds would otherwise crack and force off the coats of varnish. Paper also should be treated in the same manner; and have a previous strong coat of some kind of size; but it is rarely made the subject of japanning till it is converted into *papier mache*, or wrought, by other means, into such form, that its original state, particularly with respect to flexibility, is lost. One principal variation in the manner of japanning is, the using or omitting any priming or undercoat on the work to be japanned. In the older practice, such priming was always used; and is at present retained in the French manner of japanning coaches and snuff boxes of the *papier mache*. But in the Birmingham manufacture here, it has been always rejected. The advantage of using such priming or undercoat is, that it makes a saving in the quantity of varnish used; because the matter of which the priming is composed, fills up the inequalities of the body to be varnished; and makes it easy, by means of rubbing and water-polishing, to gain an even surface for the varnish. This was therefore such a convenience in the case of wood, as the giving a hardness and firmness to the ground, was also in the case of leather, that it became an established method: and is therefore retained, even in the instance of the *papier mache*, by the French, who applied the received method of japanning to that kind of work on its introduction. There is nevertheless this inconvenience always attending the use of an undercoat of size, that the japan coats of varnish and colour will be constantly liable to be cracked and peeled off, by any violence, and will not endure near so long as the bodies japanned in the same manner, but without any such priming. This may be easily observed in comparing the wear of the Paris and Birmingham snuff boxes; which latter, when good of their kind, never peel or crack, or suffer any damage, unless by great violence, and such a continued rubbing, as wastes away the substance of the varnish: while the japan coats of the Parisian boxes crack and fly off in

flakes, whenever any knock or fall, particularly near the edges, expoſes them to be injured. But the Birmingham manufacturers, who originally practiſed the japanning only on metals, to which the reaſon above given for the uſe of priming did not extend, and who took up this art of themſelves as an invention, of courſe omitted at firſt the uſe of any ſuch undercoat; and not finding it more neceſſary in the inſtance of *papier mache*, than on metals, continue ſtill to reject it. On which account the boxes of their manufacture are, with regard to the wear, greatly better than the French. The laying on the colours, in varniſh inſtead of gum water, is alſo another variation from the method of japanning formerly practiſed. But the much greater ſtrength of the work, where they are laid on in varniſh or oil, has occaſioned this way to be exploded, with the greateſt reaſon, in all regular manufactures. However, they who may practiſe japanning on cabinets, or other ſuch pieces, as are not expoſed to much wear and violence, for their amuſement only, and conſequently may not find it worth their while to encumber themſelves with the preparations neceſſary for the other methods, may paint with water colours on an undercoat laid on the wood, or other ſubſtance, of which the piece to be japanned is formed; and then finiſh with the proper coats of varniſh, according to the methods below taught. If the colours are tempered with the ſtrongeſt iſinglaſs ſize and honey, inſtead of gum water, and laid on very flat and even, the work will not be much inferior in appearance to that done by the other method; and will laſt as long as the common old japan work, except the beſt kinds of the true japan. It is practiſed likewiſe, in imitation of what is ſometimes done in the Indian work, to paint with water colours on grounds of gold; in which caſe the iſinglaſs ſize, with ſugar-candy or honey, as above directed, is the beſt vehicle. Imitations are alſo made of japan work, by colouring prints, gluing them to wood-work, and giving them a ſhining appearance, by the uſe of ſome white varniſh.

*Of japan grounds.*] The proper japan grounds are either such as are formed by the varnish and colour, where the whole is to remain of one simple colour; or by the varnish either coloured or without colour, on which some painting or other decoration, is afterwards to be laid on. It is necessary, however, before I proceed to speak of the particular grounds, to show the manner of laying on the priming or undercoat, where any such is used. This priming is of the same nature with that called clear coating (or vulgarly clear coaling) practised erroneously by house-painters; and consists only in laying on, and drying in the most even manner, a composition of size and whiting. The common size has been generally used for this purpose: but where the work is of a nicer kind, it is better to employ the glover's or the parchment size; and if a third of isinglass be added, it will be still better; and if not laid on too thick, much less liable to peel and crack. The work should be prepared for this priming, by being well smoothed with the fish skin, or glass shaver; and, being made thoroughly clean, should be brushed over once or twice with hot size, diluted with two thirds of water, if it be of the common strength. The priming should then be laid on with a brush as even as possible; and should be formed of a size, whose consistence is betwixt the common kind and glue, mixed with as much whiting as will give it a sufficient body of colour to hide the surface of whatever it is laid upon, but not more. If the surface be very even, on which the priming is used, two coats of it, laid on in this manner, will be sufficient: but if, on trial with a fine rag wet, it will not receive a proper water polish, on account of any inequalities not sufficiently filled up and covered, two or more coats must be given it: and whether a greater or less number be used, the work should be smoothed, after the last coat but one is dry, by rubbing it with the Dutch rushes. When the last coat is dry, the water polish should be given, by passing over every part of it with a fine rag gently moistened, till the whole appear perfectly clean and even. The prim-

ing will then be completed, and the work ready to receive the painting, or coloured varnish: the rest of the proceedings being the same in this case, as where no priming is used.

*Of common grounds of varnish which are to be painted upon.*] Where wood or leather is to be japanned, and no priming is used, the best preparation is to lay two or three coats of coarse varnish composed in the following manner.——"Take of rectified spirit of wine one pint, and of coarse seed lac and resin, each two ounces. Dissolve the seed lac and resin in the spirit: and then strain off the varnish."— This varnish, as well as all others formed of spirit of wine, must be laid on in a warm place; and, if it can be conveniently managed, the piece of work to be varnished should be made warm likewise: and for the same reason, all dampness should be avoided; for either cold or moisture chill this kind of varnish; and prevent its taking proper hold of the substance on which it is laid. When the work is so prepared, or by the priming of the composition of size and whiting above described, the proper japan ground must be laid on, which is much the best formed of shell-lac varnish, and the colour desired; if white be not in question, which demands a peculiar treatment, as I shall below explain; or great brightness be not required, when also other means must be pursued. The colours used with the shell-lac varnish, may be any pigments whatever which give the tint of the ground desired; and they may be mixed together to form browns or any compound colours: but with respect to such as require peculiar methods for the producing them of the first degree of brightness, I shall particularize them below. The colours for grounds may otherwise be mixed with the white varnishes formed in oil of turpentine; but these varnishes have no advantages over the shell-lac but in their whiteness, that preserves the brightness of the colours; and they are at the same time greatly inferior in hardness to it. As metals never require to be under-coated with whiting,

they may be treated in the same manner as wood or leather; when the under-coat is omitted, except in the instances particularly spoken of below.

*Of white japan grounds.*] The forming a ground perfectly white, and of the first degree of hardness, remains hitherto a desideratum, or matter sought for in the art of japanning. As there are no substances which can be dissolved, so as to form a very hard varnish, but what have too much colour not to deprave the whiteness, when laid on of a due thickness over the work, except some very late discoveries not hitherto brought into practice. The nearest approach, however, to a perfect white varnish, by means already known to the public, is made by the following composition.——"Take flake white, or white lead, washed over and ground with a sixth of its weight of starch, and then dried; and temper it properly for spreading, with the mastic varnish, or compound them with the gum animi."—Lay these on the body to be japanned, prepared either with or without the under-coat of whiting, in the manner as above ordered: and then varnish over it with five or six coats of the following varnish.——"Provide any quantity of the best seed lac; and pick out of it all the clearest and whitest grains; reserving the more coloured and fouler parts for the coarser varnishes, such as that above mentioned for priming or preparing wood or leather. Take of this picked seed lac two ounces; and of gum animi three ounces; and dissolve them, being previously reduced to a gross powder, in about a quart of spirit of wine; and strain off the clear varnish."——The seed lac will yet give a slight tinge to this composition; but cannot be omitted, where the varnish is wanted to be hard: though, where a softer will answer the end, the proportion may be diminished; and a little crude turpentine added to the gum animi, to take off the brittleness. A very good varnish, free entirely from all brittleness, may be formed, by dissolving as much gum animi, as the oil will take, in old nut or poppy oil; which must be made to boil

gently, when the gum is put into it. The ground of white colour itself may be laid on in this varnish, and then a coat or two of it may be put over the ground: but it must be well diluted with oil of turpentine when it is used. This, though free from brittleness, is, nevertheless, liable to suffer; by being indented or bruised by any slight strokes; and it will not well bear any polish, but may be brought to a very smooth surface without, if it be judiciously managed in the laying it on. It is likewise somewhat tedious in drying, and will require some time where several coats are laid on, as the last ought not to contain much oil of turpentine. It must be observed, likewise, that the gum resin, such as the animi, copal, &c. can never be dissolved in substantial oils, by the medium of heat, without a considerable change in the colour of the oils, by the degree of heat necessary to produce the solution. A method of dissolving gum copal in oil of turpentine is, however, now discovered by a gentleman of great abilities in chemistry; and he has also obtained a method of dissolving amber in the same menstruum, so that we may hope soon to see the art of japanning carried to a consummate degree of perfection; when the public are put in possession of these most important inventions, or the fruits of them.

*Of blue japan grounds.*] Blue japan grounds may be formed of bright Prussian blue; or of verditer glazed over by Prussian blue; or of smalt. The colour may be best mixed with shell-lac varnish; and brought to a polishing state by five or six coats of varnish of seed-lac. But the varnish, nevertheless, will somewhat injure the colour, by giving to a true blue a cast of green; and fouling in some degree a warm blue, by the yellow it contains. Where, therefore, a bright blue is required, and a less degree of hardness can be dispensed with, the the method before directed, in the case of white grounds, must be pursued.

*Of red japan grounds.*] For a scarlet japan ground, vermillion may be used. But the vermillion alone has

a glaring effect, that renders it much leſs beautiful than the crimſon produced by glazing it over with carmine or fine lake; or even with roſe pink, which has a very good effect uſed for this purpoſe. For a very bright crimſon, nevertheleſs, inſtead of glazing with carmine, the Indian lake, known in the ſhops by the name of *safflower*, ſhould be uſed, diſſolved in the ſpirit of which the varniſh is compounded (which it readily admits of when good). But in this caſe, inſtead of glazing with the ſhell-lac varniſh, the upper or poliſhing coats need only be uſed; as they will equally receive and convey the tinge of the Indian lake, which may be actually diſſolved by ſpirit of wine: and this will be found a much cheaper method than the uſing carmine. If, nevertheleſs, the higheſt degree of brightneſs be required, the white varniſhes muſt be uſed. It is at preſent, however, very difficult to obtain this kind of lake. For it does not appear that more than one conſiderable quantity was ever brought over, and put into the hands of colourmen: and this being now expended, they have not the means of a freſh ſupply: it, however, may be eaſily had from the ſame place whence the former quantity was procured, by any perſons who go thither in the Eaſt-India ſhips.

*Of yellow japan grounds.*] For bright yellow grounds, King's yellow, or turpeth mineral, ſhould be employed, either alone or mixed with fine Dutch pink. The effect may be ſtill more heightened, by diſſolving powdered turmeric root in the ſpirit of wine, of which the upper or poliſhing coat is made; which ſpirit of wine muſt be ſtrained from off the dregs, before the ſeed-lac be added to it to form the varniſh. The ſeed-lac varniſh is not equally injurious here, and with greens, as in the caſe of other colours; becauſe, being only tinged with a reddiſh yellow, it is little more than an addition to the force of the colours. Yellow grounds may be likewiſe formed of the Dutch pink only, which, when good, will not be wanting in brightneſs, though extremely cheap.

*Of green japan grounds.*] Green grounds may be produced by mixing King's yellow and bright Pruſſian blue; or rather, turpeth mineral and Pruſſian blue. A cheap, but fouler kind, may be had from verdigriſe, with a little of the above mentioned yellows, or Dutch pink. But where a very bright green is wanted, the cryſtals of verdigriſe, (called *diſtilled verdigriſe*) ſhould be employed; and to heighten the effect, they ſhould be laid on a ground of leaf gold, which renders the colour extremely brilliant and pleaſing. They may any of them be uſed ſucceſsfully with good ſeed-lac varniſh, for the reaſon before given: but will be ſtill brighter with the white varniſh.

*Of orange-coloured japan grounds.*] Orange-coloured japan grounds may be formed, by mixing vermillion, or red lead, with King's yellow, or Dutch pink; or the orange lake; or red orpiment, will make a brighter orange ground than can be produced by any mixture.

*Of purple japan grounds.*] Purple japan grounds may be produced by the mixture of lake, and Pruſſian blue; or a fouler kind, by vermillion and Pruſſian blue. They may be treated as the reſt, with reſpect to the varniſh.

*Of black japan grounds, to be produced without heat.*] Black grounds may be formed by either ivory-black, or lamp-black: but the former is preferable, where it is perfectly good. Theſe may be always laid on with the ſhell-lac varniſh: and have their upper or poliſhing coats of common ſeed-lac varniſh; as the tinge or foulneſs of the varniſh can be here no injury.

*Of common black japan grounds on iron or copper, produced by means of heat.*] For forming the common black japan grounds by means of heat, the piece of work to be japanned muſt be painted over with drying oil: and when it is of a moderate dryneſs, muſt be put into a ſtove of ſuch degree of heat, as will change the oil black, without burning it, ſo as to deſtroy or weaken its tenacity. The ſtove ſhould not be too hot when the work is put into it, nor the heat increaſed too

faſt; either of which errors would make it bliſter: but the ſlower the heat is augmented, and the longer it is continued, provided it be reſtrained within the due degree, the harder will be the coat of japan. This kind of varniſh requires no poliſhing, having received, when properly managed, a ſufficient one from the heat.

*Of the fine tortoiſe-ſhell japan ground, produced by means of heat.*] The beſt kind of tortoiſe-ſhell ground produced by heat is not leſs valuable for its great hardneſs, and endured to be made hotter than boiling water without damage, than for its beautiful appearance. It is to be made by means of a varniſh prepared in the following manner.——"Take of good linſeed oil one gallon, and of umbre half a pound. Boil them together till the oil become very brown and thick: ſtrain it then through a coarſe cloth; and ſet it again to boil; in which ſtate it muſt be continued till it acquire a pitchy conſiſtence, when it will be fit for uſe."—— Having prepared thus the varniſh, clean well the iron or copper-plate, or other piece which is to be japanned; and then lay vermillion tempered with ſhell-lac varniſh, or with drying oil diluted with oil of turpentine very thinly, on the places intended to imitate the more tranſparent parts of the tortoiſe-ſhell. When the vermillion is dry, bruſh over the whole with the black varniſh, tempered to a due conſiſtence with oil of turpentine; and when it is ſet and firm, put the work into a ſtove, where it may undergo a very ſtrong heat; and muſt be continued a conſiderable time, if even three weeks or a month, it will be the better. This was given amongſt other receipes by Kunckel; but appears to have been neglected till it was revived with great ſucceſs in the Birmingham manufactures, where it was not only the ground of ſnuff-boxes, dreſſing-boxes, and other ſuch leſſer pieces, but of thoſe beautiful tea waiters, which have been ſo juſtly eſteemed and admired in ſeveral parts of Europe where they have been ſent. This ground may be decorated with painting and gilding, in the ſame manner as any other var-

niſhed ſurface, which had beſt be done after the ground has been duly hardened by the hot ſtove: but it is well to give a ſecond annealing with a more gentle heat after it is finiſhed.

*Of painting japan work.*] Japan work ought properly to be painted with colours in varniſh. But in order for the greater diſpatch, and, in ſome very nice works in ſmall, for the freer uſe of the pencil, the colours are now moſt frequently tempered in oil: which ſhould previouſly have a fourth part of its weight of gum animi diſſolved in it; or, in default of that, of the gums ſanderac or maſtic, as I have likewiſe before intimated. When the oil is thus uſed, it ſhould be well diluted with ſpirit of turpentine, that the colours may be laid more evenly and thin: by which means, fewer of the poliſhing or upper coats of varniſh become neceſſary. In ſome inſtances, water colours, as I before mentioned, are laid on grounds of gold, in the other paintings; and are beſt, when ſo uſed, in their proper appearance, without any varniſh over them; and they are alſo ſometimes ſo managed, as to have the effect of emboſſed work. The colours employed in this way for painting, are (as I before intimated) beſt prepared by means of iſinglaſs ſize corrected with honey, or ſugar-candy. The body of which the emboſſed work is raiſed, need not, however, be tinged with the exterior colour; but may be beſt formed of very ſtrong gum water, thickened to a proper conſiſtence by bole ammoniac and whiting in equal parts: which being laid on in the proper figure, and repaired when dry, may be then painted with the proper colours tempered in the iſinglaſs ſize, or in the general manner with ſhell-lac varniſh.

*Of varniſhing japan work.*] The laſt, and finiſhing part of japanning, lies in the laying on and poliſhing the outer coats of varniſh; which are neceſſary, as well in the pieces that have only one ſimple ground of colour; as with thoſe that are painted. This in general is beſt done with common ſeed-lac varniſh; except in

the inſtances, and on thoſe occaſions, where I have already ſhown other methods to be more expedient: and the ſame reaſons, which decide as to the fitneſs or impropriety of the varniſhes, with reſpect to the colours of the ground, hold equally well with regard to thoſe of the painting. For where brightneſs is the moſt material point, and a tinge of yellow will injure it, feed-lac muſt give way to the whiter gums. But where hardneſs, and a greater tenacity, are moſt eſſential, it muſt be adhered to: and where both are ſo neceſſary, that it is proper one ſhould give way to the other, in a certain degree reciprocally, a mixed varniſh muſt be adopted. This mixed varniſh, as I before obſerved, ſhould be made of the pick'd ſeed-lac, as directed in p. 43. The common ſeed-lac varniſh, which is the moſt uſeful preparation of the kind hitherto invented, may be thus made. "Take of ſeed-lac three ounces, and put into water to free it from the ſticks and filth that frequently are intermixed with it; and which muſt be done by ſtirring it about, and then pouring off the water and adding freſh quantities, in order to repeat the operations till it be free from all impurities; as it very effectually may be by this means. Dry it then, and powder it groſsly; and put it, with a pint of rectified ſpirit of wine, into a bottle, of which it will not fill above two-thirds. Shake the mixture well together, and place the bottle in a gentle heat, till the ſeed appear to be diſſolved; the ſhaking being in the mean time repeated as often as may be convenient; and then pour off all which can be obtained clear by that method: and ſtrain the remainder through a coarſe cloth. The varniſh thus prepared muſt be kept for uſe in a bottle well ſtopt."——When the ſpirit of wine is very ſtrong, it will diſſolve a greater proportion of the ſeed-lac: but this will ſaturate the common, which is ſeldom of a ſtrength ſufficient for making varniſhes in perfection. As the chilling, which is the moſt inconvenient accident attending thoſe of this kind, is prevented, or produced more frequently, according to the ſtrength of the

ſpirit, I will take this opportunity of ſhowing a method by which weaker rectified ſpirits may with great eaſe, at any time, be freed from the phlegm, and rendered of the firſt degree of ſtrength.——"Take a pint of the common rectified ſpirit of wine, and put it into a bottle, of which it will not fill above three parts. Add to it half an ounce of pearl-aſhes, ſalt of tartar, or any other alkaline ſalt, heated red-hot, and powdered, as well as it can be without much loſs of its heat. Shake the mixture frequently for the ſpace of half an hour; before which time, a great part of the phlegm will be ſeparated from the ſpirit; and will appear, together with the undiſſolved part of the ſalts in the bottom of the bottle. Let the ſpirit then be poured off, or freed from the phlegm and ſalts by means of a *tritorium*, or ſeparating funnel; and let half an ounce of the pearl-aſhes, heated and powdered as before, be added to it, and the ſame treatment repeated. This may be done a third time, if the quantity of phlegm ſeparated by the addition of the pearl-aſhes appear conſiderable. An ounce of alum reduced to powder and made hot, but not burned, muſt then be put into the ſpirit; and ſuffered to remain ſome hours; the bottle being frequently ſhaken. After which, the ſpirit, being poured off from it, will be fit for uſe."——The addition of the alum is neceſſary, to neutralize the remains of the alkaline ſalt or pearl-aſhes; which would otherwiſe greatly deprave the ſpirit with reſpect to varniſhes and laquers, where vegetable colours are concerned; and muſt conſequently render another diſtillation neceſſary. The manner of uſing the ſeed-lac, or white varniſhes, is the ſame; except with regard to the ſubſtance uſed in poliſhing; which where a pure white, or great clearneſs of other colours, is in queſtion, ſhould be itſelf white: whereas the browner ſorts of poliſhing duſt, as being cheaper, and doing their buſineſs with greater diſpatch, may be uſed in other caſes. The pieces of work to be varniſhed ſhould be placed near a fire, or in a room where there is a ſtove; and made perfectly dry: and then the varniſh may be rubbed over them by the

proper brushes made for that purpose, beginning in the middle, and passing the brush to one end; and then, with another stroke from the middle, passing it to the other. But no part should be crossed or twice passed over, in forming one coat, where it can possibly be avoided. When one coat is dry, another must be laid over it; and this must be continued at least five or six times, or more; if, on trial, there be not a sufficient thickness of varnish to bear the polish, without laying bare the painting, or the ground-colour underneath. When a sufficient number of coats is thus laid on, the work is fit to be polished: which must be done, in common cases, by rubbing it with a rag dipped in tripoli (commonly called *rotten stone*) finely powdered. But towards the end of the rubbing, a little oil of any kind should be used along with the powder; and when the work appears sufficiently bright and glossy, it should be well rubbed with the oil alone, to clean it from the powder; and give it a still brighter lustre. In the case of white grounds, instead of the tripoli, fine putty or whiting must be used; both which should be washed over, to prevent the danger of damaging the work from any sand or other gritty matter, that may happen to become mixed with them. It is a great improvement of all kinds of japan work, to harden the varnish by means of heat; which, in every degree that it can be applied short of what would burn or calcine the matter, tends to give it a more firm and strong texture. Where metals form the body, therefore, a very hot stove may be used, and the pieces of work may be continued in it a considerable time; especially if the heat be gradually increased. But where wood is in question, heat must be sparingly used; as it would otherwise warp or shrink the body, so as to injure the general figure.

*Of gilding japan work* ] All the methods of gilding, which are applicable to the ornamenting japan work, having been before taught under the article of gilding, it is needless to repeat them here. I shall therefore only again observe, that in gilding with gold size (which is

almoſt the only method now practiſed in japan work) where it is deſired to have the gold not to ſhine, or approach in the leaſt towards the burniſhing ſtate, the ſize ſhould be uſed either with oil of turpentine only, or with a very little fat oil. But where a greater luſtre, and appearance of poliſh, are wanting, without the trouble of burniſhing, and the preparation neceſſary for it, fat oil alone, or mixed with a little gold ſize, ſhould be uſed; and the ſame proportionable effect will be produced from a mean proportion of them.

*Of laquering.*] Laquering is the laying either coloured or tranſparent varniſhes on metals, in order to produce the appearance of a different colour in the metal; or to preſerve it from ruſt and the injuries of the weather. Laquering is therefore much of the ſame nature with japanning, both with regard to the principles and practice; except that no opake colours, but tranſparent tinges alone, are to be employed. The occaſions on which laquering is now in general uſed, are three: where braſs is to be made to have the appearance of being gilt: where tin is wanted to have the reſemblance of yellow metals: and where braſs or copper locks, nails, or other ſuch matters, are to be defended from the corroſion of the air or moiſture. There was indeed formerly another very frequent application of laquering; which was colouring frames of pictures, &c. previouſly ſilvered, in order to give them the effect of gilding; but this is now greatly diſuſed. Theſe various intentions of laquering require different compoſitions for the effectuating each kind; and as there is a multiplicity of ingredients which may be conducive to each purpoſe, a proportionable number of recipes have been deviſed, and introduced into practice; eſpecially for the laquering braſs work to imitate gilding; which is a conſiderable object in this kind of art; and has been improved to the greateſt degree of perfection. I ſhall, however, only give one or two recipes for each; as they are all which are neceſſary; the others being either made too complex by ingredients not eſſential to the intention, or too coſtly by the uſe of ſuch as are expenſive; or inferior in goodneſs, from the im-

proper choice of proportion of the component ſubſtances. The principal body or matter of all good laquers uſed at preſent is ſeed-lac; but, for coarſer uſes, reſin or turpentine is added; in order to make the laquer cheaper, than if the ſeed lac, which is a much dearer article, be uſed alone. Spirit of wine is alſo conſequently the fluid or menſtruum of which laquers is formed; as the ethereal oils will not diſſolve the ſeed-lac: and it is proper that the ſpirit ſhould be highly rectified for this purpoſe. As it is ſeldom practicable, nevertheleſs, to procure ſuch ſpirits from the ſhops, it will be found very advantageous to uſe the method above given for dephlegmating it by alkaline ſalts; but the uſe of the alum, directed in that proceſs, muſt not be forgotten on this occaſion; as the effect of the alkaline ſalt would otherwiſe be the turning the metal of a purpliſh, inſtead of a golden colour, by laying on the laquer. The following are excellent compoſitions for braſs work which is to reſemble gilding.—"Take of turmeric ground, as it may be had at the dry ſalters, one ounce, and of ſaffron and Spaniſh annatto each two drachms. Put them into a proper bottle, with a pint of highly-rectified ſpirit of wine; and place them in a moderate heat, if convenient, often ſhaking them, for ſeveral days. A very ſtrong yellow tincture will then be obtained; which muſt be ſtrained off from the dregs through a coarſe linen cloth: and then, being put back into the bottle, three ounces of good ſeed-lac powdered groſsly muſt be added, and the mixture placed again in a moderate heat, and ſhaken, till the ſeed-lac be diſſolved; or at leaſt ſuch part of it as may. The laquer muſt then be ſtrained as before; and will be fit for uſe; but muſt be kept in a bottle carefully ſtopt."——Where it is deſired to have the laquer warmer or redder than this compoſition may prove, the proportion of the annato muſt be increaſed; and where it is wanted cooler, or nearer a true yellow, it muſt be diminiſhed. The above, properly managed, is an extreme good laquer; and of moderate price; but the following, which is cheaper, and may be made where the Spaniſh annatto cannot be procured good, is not greatly inferior to it.——"Take of turmeric two

ground one ounce, of the beſt dragon's blood half a drachm. Put them to a pint of ſpirit of wine, and proceed as with the above."—By diminiſhing the proportion of the dragon's blood, the varniſh may be rendered of a redder, or truer yellow caſt. Saffron is ſometimes uſed to form the body of colour in this kind of laquer, inſtead of the turmeric; but though it makes a warmer yellow, yet the dearneſs of it, and the advantage which turmeric has in forming a much ſtronger tinge in ſpirit of wine, not only than the ſaffron, but than any other vegetable matter hitherto known, gives it the preference. Tho' being a true yellow, and conſequently not ſufficiently warm to overcome the greeniſh caſt of braſs, it requires the addition of ſome orange coloured tinge to make a perfect laquer for this purpoſe. Aloes and gamboge are alſo ſometimes uſed in laquers for braſs: but the aloes is not neceſſary where turmeric or ſaffron are uſed; and the gamboge, though a very ſtrong milky yellow in water, affords only a very weak tinge in ſpirit of wine. The varniſh for tin may be made as follows:—"Take of turmeric root one ounce, of dragon's blood two drachms, and of ſpirit of wine one pint. Proceed as in the former."—This may, like the former, have the red or yellow rendered more prevalent, by the increaſing or diminiſhing the proportion of the dragon's blood. Where a coarſer or cheaper kind is wanted, the quantity of ſeed-lac may be abated; and the deficiency thence ariſing ſupplied by the ſame proportion of reſin. The laquer for locks, nails, &c. where little or no colour is deſired, may either be ſeed-lac varniſh alone, as prepared above, or with a little dragon's blood: or a compound varniſh of equal parts of ſeed-lac and reſin, with or without the dragon's blood. The laquer for picture frames, &c. where the ground is ſilver, and the appearance of gilding is to be produced, may be the compoſition before given, p. 28, for gilding leather: the principle being exactly the ſame in this caſe and that. The manner of laying on the laquer is as follows: Firſt let the pieces of work to be laquered, be made thoroughly clean; which, if they be new ſcurfed, muſt be done by means of *aqua-*

*fortis*. Being ready, they must be heated by a small charcoal fire in a proper vessel, or any way that may be most convenient: the degree must not be greater than will admit of their being taken hold of without burning the hand. The laquer must then be laid on by a proper brush in the manner of other varnishes; and the pieces immediately set again in the same warm situation. After the laquer is thoroughly dry and firm, the same operation must be renewed again for four or five times, or till the work appear of the colour and brightness intended. For very fine work, some use a less proportion of seed-lac; which occasions the laquer to lie evener on the metal: but, in this case, a greater number of coats are required; which multiplies the proportion of labour; though, where the price of the work will allow for such additional trouble, it will be the more perfect for it. The laquering tin may be performed in the same manner, as is here directed for brass: but being for coarser purposes, less nicety is observed; and fewer coats (or perhaps one only) are made to suffice; as the laquer is compounded very red, that the tinge may have the stronger effect. Locks, nails, &c. where laquer is only used in a defensive view, to keep them from corroding, and not for the improvement of the colour, may be treated in the same manner: but one or two coats are generally thought sufficient. Though where any regard is had to the wear, the coats of laquer or varnish should always be of a due thickness, when they are to be exposed to the air; otherwise, the first moist weather makes them chill, and look grey and misty, in such manner, that they are rather injurious than beneficial to the work they are laid upon. The laquering picture frames, &c. where the ground is leaf silver, may be performed in the same manner as was before directed in the case of gilding leather; the circumstances being nearly the same, except with relation to the texture of the subject; to suit which, the different manner of treatment may be easily adapted. But the laquer, as was before observed, may be the same.

*Of staining wood yellow.*] Take any white wood, and

brush it over several times with the tincture of turmeric root, made by putting an ounce of the turmeric ground to powder to a pint of spirit; and, after they have stood some days, straining off the tincture. If the yellow colour be desired to have a redder cast, a little dragon's blood must be added, in the proportion that will produce the teint required. A cheaper, but less strong and bright yellow, may be given to the wood, by rubbing it over several times with the tincture of the French berries, made boiling hot. After the wood is again dry, it should be brushed over with a weak alum water used cold. Lesser pieces of wood, instead of being brushed over with them, may be soaked in the decoctions or tinctures. Wood may be also stained yellow by means of *aquafortis*; which will sometimes produce a very beautiful yellow colour, but at other times a browner. The wood should be warm, when the *aquafortis* is laid on; and be held to the fire immediately afterwards; and care must be taken, that either the *aquafortis* be not too strong, or that it be sparingly used; otherwise a brown, sometimes even a blackish colour, may be the result. In order to render any of these stains more beautiful and durable, the wood should be brushed over after it is coloured; and then varnished by the seed lac varnish; or when desired to be very strong, and to take a high polish, with three or four coats of shell-lac varnish.

*Of staining wood red.*] For a bright red stain for wood, make a strong infusion of Brasil in stale urine, or water impregnated with pearl ashes, in the proportion of an ounce to a gallon; to a gallon of either of which, the proportion of Brasil wood must be a pound: which being put to them, they must stand together two or three days, often stirring the mixture. With this infusion strained, and made boiling hot, brush over the wood to be stained, till it appear strongly coloured: then, while yet wet, brush it over with alum-water made in the proportion of two ounces of alum to a quart of water. For a less bright red, dissolve an ounce of dragon's blood in a pint of spirit of wine, and brush over the wood with the

incture, till the ſtain appear to be as ſtrong as is deſired. But this is, in fact, rather laquering than ſtaining. For a pink or roſe red, add to a gallon of the above infuſion of Braſil wood two additional ounces of the pearl aſhes, and uſe it as was before directed: but it is neceſſary, in this caſe, to bruſh the wood over often with the alum-water. By increaſing the proportion of pearl-aſhes, the red may be rendered yet paler: but it is proper, when more than this quantity is added, to make the alum-water ſtronger. Theſe reds, when it is neceſſary, may be varniſhed as the yellows.

*Of ſtaining wood blue.*] Wood may be ſtained blue, by means either of copper or indigo: but the firſt will afford a brighter colour; and is more generally practicable than the latter. Becauſe the indigo can be uſed only in that ſtate to which it is brought by the manner of preparation uſed by the dyers: of whom indeed it muſt be had, as it cannot be properly ſo prepared but in large quantities, and with a particular apparatus. The method of ſtaining blue with the copper is therefore as follows:——"Take a ſolution of copper, and bruſh it, while hot, ſeveral times over the wood. Then make a ſolution of pearl-aſhes, in the proportion of two ounces to a pint of water; and bruſh it hot over the wood, ſtained with the ſolution of copper, till it be of a perfectly blue colour." Wood ſtained green as above by verdigriſe, may likewiſe be made blue, by uſing the ſolution of the pearl aſhes in the ſame manner. When indigo is uſed for ſtaining wood blue, it muſt be managed thus:——"Take indigo prepared with ſoap lees as when uſed by the dyers; and bruſh the wood with it boiling hot. Prepare then a ſolution of white tartar, or cream of tartar, which is to be made, by boiling three ounces of the tartar, or cream, in a quart of water: and with this ſolution, uſed copiouſly, bruſh over the wood before the moiſture of the tincture of indigo be quite dried out of it."——Theſe blues muſt be bruſhed and varniſhed as the reds, where there is occaſion.

*Of ſtaining wood of mahogany colour.*] Mahogany colour is the moſt uſeful of any ſtain for wood (eſpeci-

ally ſince the veneering with different colours is out of faſhion) as it is much practiſed at preſent for chairs and other furniture made in imitation of mahogany; which, when well managed, may be brought to a very near reſemblance. This ſtain may be of different hues, as the natural wood varies greatly, being of all the intermediate teints betwixt the red brown and purple brown, according to the age, or ſometimes the original nature of different pieces. For the light red brown, uſe a decoction of madder and fuſtic wood, ground in water; the proportion may be half a pound of madder, and a quarter of a pound of fuſtic, to a gallon: or in default of fuſtic, an ounce of the yellow berries may be uſed. This muſt be bruſhed over the wood to be ſtained, while boiling hot, till the due colour be obtained; and, if the wood be kindly grained, it will have greatly the appearance of new mahogany. The ſame effect nearly may be produced by the tincture of dragon's blood and turmeric root, in ſpirit of wine: by increaſing or diminiſhing the proportion of each of which ingredients, the brown ſtain may be varied to a more red or yellow caſt at pleaſure. This ſucceeds better upon wood, which has already ſome tinge of brown, than upon white. For the dark mahogany, take the infuſion of madder made as above, except the exchanging the fuſtic for two ounces of logwood: and when the wood to be ſtained has been ſeveral times bruſhed over, and is again dry, it muſt be ſlightly bruſhed over with water in which pearl-aſhes have been diſſolved, in the proportion of about a quarter of an ounce to a quart. Any ſtains of the intermediate colours may be made, by mixing theſe ingredients, or varying the proportion of them. Where theſe ſtains are uſed for better kind of work, the wood ſhould be afterwards varniſhed with three or four coats of ſeed lac varniſh; but for coarſe work, the varniſh of reſin and ſeed lac may be employed, or they may be only well rubbed over with drying oil.

*Of ſtaining wood green.*] Diſſolve verdigriſe in vinegar, or cryſtals of verdigriſe in water; and, with

the hot solution, brush over the wood till it be duly stained. This may be brushed and varnished as the above.

*Of staining wood purple.*] Brush the wood to be stained several times with a strong decoction of logwood and Brasil, made in the proportion of one pound of the logwood and a quarter of a pound of the Brasil, to a gallon of water; and boiled for an hour or more. When the wood has been brushed over there will be a sufficient body of colour, let it dry; and then be slightly passed over by a solution of one drachm of pearl-ashes in a quart of water. This solution must be carefully used, as it will gradually change the colour from a brown red, which it will be originally found to be, to a dark blue purple; and therefore its effect must be restrained to the due point for producing the colour desired. This may be varnished as the rest.

*Of staining wood black.*] Brush the wood several times with the hot decoction of logwood made as above; but without the Brasil. Then having prepared an infusion of galls, by putting a quarter of a pound of powdered galls to two quarts of water, and setting them in the sunshine, or any other gentle heat, for three or four days, brush the wood three or four times over with it: and then pass over it again, while yet wet, with a solution of green vitriol in water, in the proportion of two ounces to a quart. The above is the cheapest method: but a very fine black may be produced, by brushing the wood several times over with a solution of copper in *aquafortis*; and afterwards with the decoction of logwood, which must be repeated till the colour be of a sufficient force; and the greenness produced by the solution of the copper, wholly overcome. These blacks may be varnished as the colours. ——Where the stains are desired to be very strong, as in the case of wood intended to be used for veneering, it is in general necessary, they should be soaked, and not brushed; to render which the more practicable, the wood may be previously slit or sawed into pieces of a proper thickness for inlaying. It is to be understood

alſo, that when the wood is above ordered to be bruſhed ſeveral times over with the tinging ſubſtances, it ſhould be ſuffered to dry betwixt each time.

*Of ſtaining ivory, bone, or horn, yellow.*] Boil them firſt in a ſolution of alum, in the proportion of one pound to two quarts of water: and then prepare a tincture of the French berries, by boiling half a pound of the berries, pounded, in a gallon of water with a quarter of a pound of pearl-aſhes. After this tincture has boiled about an hour, put the ivory, &c. previouſly boiled in the alum water, into it; and let them remain there half an hour. If turmeric root be uſed inſtead of the French berries, a brighter yellow may be obtained; but the ivory, &c. muſt in that caſe be again dipped in alum-water after it is taken out of the tincture; otherwiſe an orange colour, not a yellow, will be produced from the effect of the pearl-aſhes on the turmeric.

*Of ſtaining ivory, bone and horn, green.*] They muſt be boiled in a ſolution of verdigriſe in vinegar; or of copper in *aquafortis*, prepared as above directed, (a veſſel of glaſs or earthen ware being employed for this purpoſe) till they be of the colour deſired.

*Of ſtaining ivory, bone and horn, red.*] Take ſtrong lime water, prepared as for other purpoſes; and the raſpings of Braſil wood, in the proportion of half a pound to a gallon. Let them boil for an hour; and then put in the ivory, &c. prepared by boiling in alum water in the manner above directed for the yellow; and continue it there till it be ſufficiently coloured. If it be too crimſon, or verge towards the purple, it may be rendered more ſcarlet, by dipping again in the alum water.

*Of ſtaining ivory, bone and horn, blue.*] Stain the ivory, &c. firſt green, according to the manner above directed; and then dip it in a ſolution of pearl-aſhes made ſtrong and boiling hot; but it muſt not be continued longer, nor dipped oftener than is neceſſary to convert the green to blue. The ivory, &c. may otherwiſe be boiled in the tincture of indigo prepared as by

the dyers; and afterwards in the solution of tartar made as is directed for the staining wood.

*Of staining ivory, bone and horn, purple.*] Treat them in the same manner as was directed for red; except that logwood must be substituted in the place of Brasil wood; and the use of the alum water must be omitted wholly. If a redder purple be wanted, a mixture of the logwood and Brasil must be employed, instead of the logwood alone. The proportion may be equal parts; or any less proportion of the Brasil, according to the colour desired.

*Of staining horn to imitate tortoise-shell.*] The horn to be stained must be first pressed into proper plates or scales, or other flat form. The following mixture must then be prepared—— "Take of quicklime two parts, and of litharge one; and temper them to the consistence of a soft paste with soap lye."——Put this paste over all the parts of the horn, except such as are proper to be left transparent, in order to the greater resemblance of the tortoise-shell. The horn must then remain thus covered with the paste till it be thoroughly dry: when the paste being brushed off, the horn will be found partly opake, and partly transparent, in the manner of tortoise shell; and when put over a foil, of the kind of latten called *assidae*, will be scarcely distinguishable from it. It requires some degree of fancy, and judgment, to dispose of the paste in such a manner, as to form a variety of transparent parts of different magnitude and figure, to look like the effect of nature; and it will be an improvement to add semi transparent parts. This may be done by mixing whiting with some of the paste to weaken its operation in particular places; by which spots of a reddish brown will be produced; that, if properly interspersed, especially on the edges of the dark parts, will greatly increase as well the beauty of the work, as its similitude with the real tortoise shell.

*To stain ivory, bone and horn, black.*] Proceed in the same manner as is above directed for wood.

*Of staining paper or parchment, yellow.*] Paper may

be ſtained yellow by the tincture of French berries; but a much more beautiful colour may be obtained by uſing the tincture of turmeric formed by infuſing an ounce or more of the root powdered in a pint of ſpirit of wine. This may be made to give any teint of yellow, from the lighteſt ſtraw to the full colour, called French yellow; and will be equal in brightneſs even to the beſt dyed ſilks. If yellow be wanted of a warmer or redder caſt, annatto, or dragon's blood, muſt be added to the tincture. The beſt manner of uſing theſe and the following tinctures, is to ſpread them even on the paper or parchment by means of a broad bruſh in the manner of varniſhing.

*Of ſtaining paper or parchment, red.*] Paper or parchment, may be ſtained red, by treating it in the ſame manner as is directed for wood, p. 56; or by red ink. It may alſo be ſtained of a ſcarlet hue by the tincture of dragon's blood in ſpirit of wine: but this will not be bright. A very fine crimſon ſtain may be given to paper, by a tincture of the Indian lake, which may be made, by infuſing the lake ſome days in ſpirit of wine; and then pouring off the tincture from the dregs.

*Of ſtaining paper or parchment, green.*] Paper or parchment, may be ſtained green, by the ſolution of verdigreſe in vinegar; or by the cryſtals of verdigriſe diſſolved in water. As alſo by the ſolution of copper in *aquafortis* made by adding filings of copper gradually to the *aquafortis* till no ebullition enſues: or ſpirit of ſalt may be uſed in the place of the *aquafortis*.

*Of ſtaining paper or parchment, blue.*] A blue colour may be given to paper or parchment, by ſtaining it green by any of the above-mentioned methods; and treating it afterwards as is directed for the ſtaining wood blue, by the ſame means, or by indigo, in the manner there explained likewiſe.

*Of ſtaining paper or parchment, orange.*] Stain the paper or parchment, firſt of a full yellow, by means of the tincture of turmeric, as above directed. Then bruſh it over with a ſolution of fixed alkaline ſalt, made by diſſolving half an ounce of pearl aſhes, or ſalt of tartar, in a quart of water, and filtering the ſolution.

*Of staining paper or parchment purple.*] Paper or parchment, may be stained purple by archal: or by the tincture of logwood, according to the method above directed for staining wood. The juice of ripe privet berries expressed, will likewise give a purple dye to paper or parchment.

*Of staining alabaster, marble, and other stones, of various colours.*] Alabaster, marble, and other stones, may be stained of a yellow, red, green, blue, purple, black, or any of the compound colours, by the means above given for staining wood. But it is better, when a strong tinge is wanted, to pour the tincture, if made in water, boiling hot on the alabaster, &c. spreading it equally on every part, then to brush it over only; though that may be sufficient where a slighter dye will suffice. When tinctures in spirit of wine are used, they must not be heated; as the spirit would evaporate, and leave the tinging gums in an undissolved state. Where stones are not perfectly white, but partake of brownness or greyness, the colour produced by the tinges will be proportionably wanting in brightness. Because the natural colour of the stone is not hid or covered by these tinges; but combines with them: and, for the same reason, if the stone be of any of the pure colours, the result will be a compound of such colour and that of the tinge.

*Of the method of preparing and colouring marbled paper.*] There are several kinds of marbled paper; but the principal difference of them lies, in the forms in which the colours are laid on the ground: some being disposed in whirles or circumvolutions; some in waving jagged lengths; and others only in spots of a roundish or oval figure. The general manner of managing each kind is, nevertheless, the same: being the dipping the paper in a solution of gum dragacanth (or, as it is commonly called, gum dragon); over which the colours, previously prepared with ox-gall and spirit of wine, are first spread. The peculiar apparatus necessary for this purpose is, a trough for containing the gum dragacanth and the colours; a comb or quill for disposing them in

the figure uſually choſen; and a burniſhing ſtone for poliſhing the paper. The trough may be of any kind of wood: and muſt be ſomewhat larger than the ſheets of paper, for marbling which it is to be employed: but the ſides of it need only riſe about two inches above the bottom: for, by making it thus ſhallow, a leſs quantity of the ſolution of the gum will ſerve to fill it. The comb may be alſo of wood, and five inches in length: but ſhould have braſs teeth, which may be about two inches long, and placed at about a quarter of an inch diſtance from each other. The burniſhing ſtone may be of jaſper, or agate: but as thoſe ſtones are very dear, when of ſufficient largeneſs, marble or glaſs may be uſed, provided their ſurface be poliſhed to a great degree of ſmoothneſs. Theſe implements being prepared, the ſolution of gum dragacanth muſt be made, by putting a ſufficient proportion of the gum, which ſhould be white, and clear from all foulneſſes, into clean water; and letting it remain there a day or two; frequently breaking the lumps and ſtirring it, till the whole ſhall appear diſſolved, and equally mixed with the water. The conſiſtence of the ſolution ſhould be nearly that of ſtrong gum water, uſed in miniature painting: and, if it appear thicker, water muſt be added; or, if thinner, more of the gum. When the ſolution is thus brought to a due ſtate, it muſt be paſſed through a linen cloth, and being then put into the trough, it will be ready to receive the colours. The colours employed for red are carmine, lake, roſe-pink, vermillion and red-lead: but the two laſt are too hard and glaring, unleſs they be mixed with roſe pink, or lake, to bring them to a ſofter caſt: and with reſpect to the carmine and lake, they are too dear for common purpoſes;—for blue, Pruſſian blue and verditer, may be uſed:—for yellow, Dutch pink and yellow ochre, may be employed:—for green, verdigriſe, a mixture of Dutch pink and Pruſſian blue, or verditer, in different proportions:——for orange, the orange lake, or a mixture of vermillion, or red-lead, with Dutch pink:—for purple, roſe-pink and Pruſſian blue. Theſe ſeveral colours

ſhould be ground with ſpirit of wine, till they be of a proper fineneſs; and then at the time of uſing them, a little fiſh gall, or, in default of it, the gall of a beaſt ſhould be added, by grinding them over again with it. The proper proportion of the gall muſt be found by trying them; for there muſt be juſt ſo much as will ſuffer the ſpots of colour, when ſprinkled on the ſolution of the gum dragacanth, to join together, without intermixing or running into each other. When every thing is thus prepared, the ſolution of the gum dragacanth muſt be poured into the trough; and the colours, being in a ſeparate pot, with a pencil appropriated to each, muſt be ſprinkled on the ſurface of the ſolution, by ſhaking the pencil, charged with its proper colour, over it: and this muſt be done with the ſeveral kinds of colour deſired, till the ſurface be wholly covered. Where the marbling is propoſed to be in ſpots of a ſimple form, nothing more is neceſſary: but where the whirles or ſnail ſhell figures are wanted, they muſt be made by means of a gooſe quill; which muſt be put among the ſpots to turn them about, till the effect be produced. The waving jagged lengths muſt be made by means of the comb above deſcribed, which muſt be paſſed through the colours from one end of the trough to the other; and will give them that appearance. But if they be deſired to be pointed both ways, the comb muſt be again paſſed through the trough in a contrary direction; or if ſome of the whirles or ſnail-ſhell figures be required to be added, they may be yet made by the means before directed. The paper ſhould be previouſly prepared for receiving the colours, by dipping it over night in water; and laying the ſheets on each other, with a weight over them, in the caſe of paper to be imprinted by copper-plates. The whole being thus ready, the paper muſt be held by two corners, and laid in the moſt gentle and even manner on the ſolution covered with the colours; and there ſoftly preſſed with the hand, that it may bear every where on the ſolution. After which, it muſt be raiſed and taken off with the ſame care; and then hung to dry acroſs a proper cord, ſuſ-

pended near at hand for that purpoſe: and in that ſtate it muſt continue, till it be perfectly dry. It then remains only to give the paper a proper poliſh; in order to which it is firſt rubbed with a little ſoap; and then muſt be thoroughly ſmoothed by the glaſs poliſhers, ſuch as are uſed for linen, and called the calender glaſſes. After which it ſhould be again rubbed by a burniſher of jaſper or agate, or, in default of them, of glaſs ground to the higheſt poliſh: for on the perfect poliſh of the paper depends in a great degree its beauty and value. Gold or ſilver powders may be uſed, where deſired, along with the colours; and require only the ſame treatment as them: except that they muſt be firſt tempered with gum water.

*The original recipe for the making Pruſſian blue, as publiſhed by Dr. Woodward.*] "Take any quantity of blood, and evaporate it to dryneſs; continuing the heat till it becomes black; but avoiding the burning any part of it to aſhes. Powder the dry matter, and mix it thoroughly with an equal weight of pearl aſhes; and calcine the mixture in an iron pot or crucible, on which a cover is put. The calcination muſt be continued ſo long as the matter emits any flame; the fire being raiſed to a conſiderable degree of heat at the end of the operation; and the matter muſt be then powdered; and put, while yet hot, into twelve times its weight of water; which muſt be again ſet on the fire to boil for the ſpace of three quarters of an hour, or more. The fluid muſt then be filtered off through a thin flannel bag, from the part remaining undiſſolved: through which remaining part freſh water ſhould be paſſed, before it be taken out of the filtering bag, to extract as much as poſſible of the ſolution: and the water thus paſſed through ſhould be added to the quantity before filtered: after which, what is retained in the bag may be thrown away. In the mean time a ſolution ſhould be made of alum, and copperas calcined to whiteneſs, in the proportion of two pounds of the alum, and two ounces of the calcined vitriol, to each pound of the pearl aſhes uſed with the blood, which ſo-

lution muſt be made by boiling the alum and copperas in five times their weight of water, and then filtering them through flannel or paper, where great nicety is required. When the ſolution of the alum and copperas is thus prepared; it muſt be added to the lixivium filtered off from the calcined blood and pearl-aſhes; from which mixture, the precipitation of a blackiſh green matter will ſoon enſue. After the precipitated matter has ſubſided to the bottom of the veſſel, and the fluid appears clear over it, ſeparate it from the green ſediment, firſt by pouring off all that will run clear out of the veſſel, and afterwards by ſtraining off the remainder; and then put the green matter again into a veſſel, that will contain as much fluid as it was before mixed with. Add ſpirit of ſalt to it afterwards, in the proportion of ſix ounces to every pound of the pearl-aſhes uſed; and the green matter will then ſoon appear to be converted into a beautiful blue. Water muſt then be added, to waſh off the ſpirit of ſalt; which muſt be renewed ſeveral times, till it come off perfectly ſweet; and the laſt quantity muſt then be ſtrained off; and the blue ſediment dried in lumps of a moderate ſize. The produce will be about three ounces for every pound of the pearl-aſhes employed."——If the produce be deſired to be made either of a lighter or darker hue, it may be done by increaſing the proportion of the pearl-aſhes to the blood, to give a lighter kind; or the ſpirit of ſalt to the pearl-aſhes, to give a deeper kind: but the quantity will in the latter caſe be proportionably diminiſhed. The ſtraining or filtering the lixivium through flannel is not ſo good a method as the doing it thro' paper; eſpecially where the colour is wanted of a very great brightneſs and purity: and the water is beſt ſeparated from the great ſediment firſt produced, and afterwards from the blue one, by the ſame means: but in theſe caſes a fine linen cloth much worn, though whole, ſhould be laid over the paper. The co'our, when reduced to a proper conſiſtence, may be laid on chalk ſtones to dry: and a moderate heat may be alſo uſed for greater expedition, when required; but great care

ſhould be taken not to burn the matter. The calcination may be performed in a reverberatory furnace, ſuch as is uſed by the chemiſts; or in the furnaces where metals are melted; for the crucible or pot, containing the matter, may either be ſurrounded by the coals, or placed over them, provided a ſufficient heat be given to it. But where larger quantities are to be calcined, they may be very cheaply and commodiouſly managed in the potters or the tobacco-pipe-makers furnaces; being put into them along with the earthen ware and pipes.

*The Engliſh Fifty Pounds Premium Receipt for either taking or deſtroying Rats, or Mice, without Poiſon.*] There is no better place of ſecurity to decoy theſe vermin into than a large round wire cage, made in form of the common mouſe traps, about ſixteen inches wide, with ſeveral places for entrance: thoſe for receiving mice ſhould be much ſmaller, and ſo ſhould the holes they enter at. It will be neceſſary, firſt, to obſerve the places they moſt frequent, and to diſcover the holes they make for paſſing and repaſſing. The traps are to be ſet within four or five yards of theſe holes, and from which, quite to thoſe traps, the floor is to be rubbed (in a ſtrait line about four inches wide) with a piece of ſtrong rich cheeſe toaſted, on which a few drops of oil of anniſeed has been dropped, and the trap ſhould be well rubbed likewiſe. *Baits for the traps are to be made thus:* Of ſtrong cheeſe eight ounces; oatmeal the like quantity; ſeven or eight drops of oil of anniſeed; Indian berries one ounce; featherfew half an ounce; droppings of ſweet oil ſufficient to make it up into a paſte: then form it into many little balls, and this will moſt aſſuredly decoy them into the cage, though many people were preſent. I adviſe the uſe of traps, otherwiſe they would retire to their private haunts, and expire, which would prove very offenſive for ſome time to all near them, eſpecially in warm weather.

*The following is likewiſe by a Candidate for the Fifty Pounds Premium.*] Procure an earthen veſſel, well glazed in the inſide, near two feet high, and full one broad

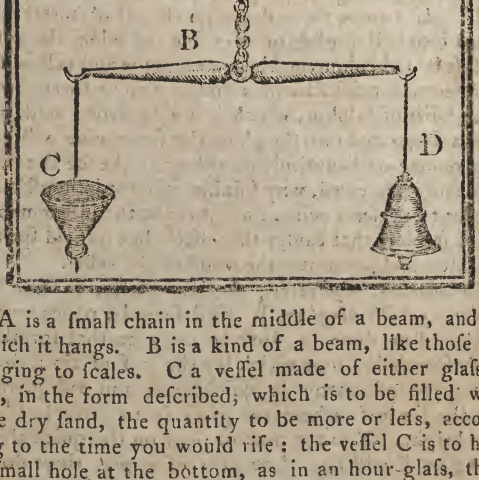
fill it to the middle with water, and hang a very ſmooth board to the top by two ſtrong pins, and ſo even that the leaſt weight will trip it up on either ſide; this board is to be well daubed over with the greaſy compoſition before mentioned, (only he leaves out the featherfew) which entices the vermin on the board, and that ſlides them into the water, from whence there is no eſcaping.

*Diſcovery of the true reaſon of burning ſulphur in hogſheads for preſerving wine, by a new and curious experiment.*] If two or three drops of the oil of tartar are poured into half a glaſs of very fine red wine, the wine will loſe its red colour, and become opaque and yellowiſh, as turned and pricked wine; but if two or three drops of the ſpirit of ſulphur, which is a very ſtrong acid, are afterwards poured into the glaſs, the ſame wine will entirely reſume its beautiful red colour; whence the reaſon is eaſily perceived, why ſulphur is burnt in hogſheads in order to preſerve wine, ſince it is not the inflammable part of ſulphur that cauſes this effect, but its acid ſpirit, that enters and permeates the wood of the veſſel.

*The manner of ſilvering Looking-glaſſes, as done in London and Birmingham.*] Firſt ſpread a paper on an even board or ſtone (a ſtone is beſt) on that ſprinkle a little fine chalk, over which lay the leaf of tin: then dip a piece of cotton in quickſilver, and rub gently over the tin leaf (where the glaſs is to cover) till it looks bright. You are now to pour on the quickſilver as long as it will lie. Lay ſlips of paper, three double on each ſide, to ſupport the glaſs, and then gently move it forward, keeping your hand preſſing on it, to force out the ſuperfluous quickſilver; let it be removed to another flat board, or ſtone, or lay a weight on it on the ſame, and in a day or two it will be dry. Note, for large plate glaſſes, a ſcrew anſwers much better than a weight laid on.

*For ſoftening Cryſtal.*] It muſt be left ſome time in the milk of a goat which has been made to feed during forty ſix days on ivy leaves. The uſe of this milk has been proved to be of ſingular ſervice to thoſe troubled with the gravel.

*The useful Alarm-Bell.*] This is originally a Dutch invention, and by which a person may be enabled to rise at any time of the night; or know how time goes as well as by a clock, or watch, by observing the following directions.




A is a small chain in the middle of a beam, and by which it hangs. B is a kind of a beam, like those belonging to scales. C a vessel made of either glass or tin, in the form described, which is to be filled with fine dry sand, the quantity to be more or less, according to the time you would rise: the vessel C is to have a small hole at the bottom, as in an hour-glass, thro' which the sand is to pass. D is along at the opposite end of the beam B. When the vessel C is empty, the bell D is to be a very little heavier than C, by which means, after the sand is all discharged, the bell D becoming more weighty than C, the ballance instantly falls on that side, and the bell continues ringing for some time, and by which noise the person is called at the time required. The way to proportion the sand to the time is thus: Suppose a person required to be called in four hours after going to rest: if, on trial, half a pound of sand will run four hours, then that is to be the quantity; if in six hours, then

12 ounces are to be put into the veſſel; if in eight hours, one pound, and ſo in proportion to the time it is to run.

*For ſoftening Ivory and Bones.*] Take ſage, boil it in ſtrong vinegar, ſtrain the decoction through a piece of cloſe cloth; and, when you have a mind to ſoften bones or ivory, ſteep them in this liquor, and the longer they remain in it, the ſofter they will grow.

*Another preparation for ſoftening bones.*] Take roman-vitriol and common ſalt, of each one pound; bruiſe and reduce them into an impalpable powder; put them into an alembic: the diſtilled water will have the virtue of ſoftening bones; and, to ſucceed therein, they need only be left to ſteep in it for half a day.

*For ſoftening glaſs.*] Take the blood of a he goat and a duck, ſome dregs of oil and vinegar; mix theſe things together, and put them into a varniſhed earthen pot: let the whole be warmed a little, and afterwards, having put ſome glaſs in, let it there remain till it becomes ſoft.

*A ready way for melting iron.*] Take ſulphur, mix it with a little ſalt, and dilute the mixture with a child's urine, till it becomes white: beſmear the iron with it, and you will ſoon ſee it liquefy. As to the more compact and harder metals, fire alone can make them liquefy.

*The virtues of Succinum.*] Mizaldus ſays, that faſtened about the neck, it radically and ſurpriſingly cures the fiſtula lachrymalis and ſoreneſs of the eyes. A woman of Copenhagen, being tormented with a continual pain of the head, was adviſed to wear an amber necklace, whereupon the pain ſoon vaniſhed. This induced her to leave it off but ſeldom, and only when ſhe was apprehenſive it cauſed too great a dryneſs, by diſſipating too great a quantity of her humours. This obſervation is ſupported by that of Caſpard Scholler, a magiſtrate of the ſame city, who is laviſh of his commendations of ſuccinum, having himſelf found very good effects by it.

*A remarkable circumſtance concerning ale; with an unerring method of brewing malt liquor, that will ſoon be fine and fit for drinking; and far more palatable and*

*wholesome than what is procured from the too common, erroneous way many brewers follow.*] Whoever brews, and expects to have either good ale or beer, will be sure to be disappointed, if care is not taken to provide good malt and hops; nor is the water made use of so very immaterial an article as some imagine, for a great deal depends upon it. What I have above advanced, may very likely be credited by many; but when I come to tell them, there is more malt liquor spoiled by high boiling, than by all mismanagements put together, it is easy to perceive I shall have many obstinate infatuated people to encounter with, who very simply imagine, that ale or beer, cannot possibly be bad which has had a four hours boiling. It is well known there are many parts of England remarkable for fine malt liquors; and I as well know, that not one of the counties that have excelled in either ale or beer, ever boiled above half an hour at most. There is, indeed, a town in Devonshire, that is said to have constantly good ale. I am well acquainted with it; Barnstable, no doubt, has a strong glutinous ale, that pleases many people; and those who brew, I dare say, most scandalously boil it, at least four hours. But what is the consequence? Why there is scarce a house in that place but affords a pair or two of crutches, and unhappy cripples to make use of them. I must own people in England have not followed this pernicious custom so much of late years. They find they are gainers by their reformation; and many have owned, they never had such valuable ale or beer, as since they left off the old mistaken way of boiling for three or four hours, and acknowledge they have reduced it to less than a quarter of that time. There are others again, who declare, to their customers, that they actually boil four hours: when in fact, a quarter of an hour is the most they have boiled for five or six years past. I believe this reformation is chiefly owing to some treatises published concerning brewing, in which the pernicious consequence of high boiling is sufficiently displayed and exploded. I will beg leave o give an instance of the bad consequences of long boiling, that

will be sufficient to satisfy any person who practises it, of their error. A gentleman of my acquaintance, in Chester, often complained to me, that he bought the best of malt and hops; that they had fine water from the river Dee, and he had it constantly boiled full four hours; and yet notwithstanding all this, he could not have either good ale or beer. His lady too joined in the complaint, and said, it would be a great satisfaction if a remedy could be found, as many of the gentlemen who visited there preferred a glass of fine beer to any liquor whatever. I then told him, if he would have a brewing after my direction, I would be answerable, that it would prove satisfactory. Accordingly good malt and hops were provided, and the water was fetched from the river Dee, as usual. I must own it was with the utmost difficulty I prevailed on the man who brewed to boil it so short a time, who protested it would be good for nothing. However, I at length prevailed, and he proceeded in the following manner: the quantity of liquor was sixty gallons; and to put the thing quite out of dispute, and to prove that boiling long was erroneous, the first twenty gallons were boiled twenty six minutes; the second twenty gallons one hour and a quarter: and the third and last twenty gallons full two hours. In about a month, the three casks were examined: that which was boiled twenty-six minutes, proved extremely fine and well tasted, and gave a general satisfaction. But the cask which contained the liquor of the second boiling, was very far from being either so fine or pleasant. And the third cask which contained the last and long boiled liquor, proved very foul, and quite disagreeable in many other respects. Now as there was no difference in the management of the sixty gallons of ale I have been speaking of, boiling only excepted, how will the advocates for long boiling malt liquors account for this: the same malt, hops and water, tunned at the same time, and in casks of the same size, and placed in the same good cellar. I have to add to this account, that at the two months end, the second boiling was foul and ill tasted, and was

made fine with great difficulty. The laſt boiling was very foul and bad; at the end of ſix months it was cloudy, ropy, and ill taſted; ſome attempts were made in vain, to fine it; but at about ten months old, it was far worſe. The gentleman, who, indeed, was too fond of long boiling, for many years before, as it had been often inſinuated to him, that drink could not be boiled too much, was greatly pleaſed to find the firſt caſk prove ſo exceeding good, with little boiling; he then gave orders to the man who brewed for him, never for the future, to boil his liquor above twenty minutes, which directions were ſtrictly obſerved: and it is now as uncommon to find any malt liquor that is bad in his cellars, as it was before to have any that was good. I would fain know what it is boiled for the length of four hours? Some tell you, 'tis to get the goodneſs out of the hops. To which I anſwer, it is a ſad thing ſo many thouſand gallons of malt liquor ſhould be ſpoiled every year, only to get goodneſs (as they are pleaſed to call it) out of the hops, when many other means might be uſed to do it in a few minutes. In one word, the long boiling malt-liquor has many bad properties attending it, without having any thing in its favour: for it renders ſuch ale too gummy and fizy to be wholeſome, and is the cauſe of many becoming cripples, who make a too frequent uſe of thoſe pernicious long boiled liquors: for the blood, by this means, becomes too glutinous to paſs the fine blood veſſels: hence ariſe thoſe various diſorders! thoſe pains! thoſe aches! that render the unhappy cripples not only a fatigue to themſelves, but introduce diſorders that are felt by future generations. Nor does the miſchief ſtop here (though I muſt own this is the moſt melancholy part of it) for whenever ſuch ale or beer proves foul, which is too commonly the caſe, it is with great difficulty made fine, and fit for drinking. In ſhort, thoſe who once experience the great advantage that will reſult from boiling their liquor not longer than twenty-five or thirty minutes, will be ſure to have this ſatisfaction, that their ale will be much better, plea-

ſanter, and more wholeſome, than thoſe that are long boiled; by which they will not only preſerve the health of thoſe who drink it, but alſo have more liquor from the ſame quantity of malt; which very likely may be a means of prevailing, as intereſt is in the caſe, more than any other arguments. It is to be remarked that all liquor ſhould be boiled as nimbly as poſſible (ſo as not to make it run out of the boiler) and alſo that the long ſtupid way of boiling for the goodneſs of the hop, is of the utmoſt prejudice; for its fine flavour will be ſoon extracted: what comes after, by length of ſtewing, is only an earthy, heavy, pernicious quality, that will be ſure to render the ale diſagreeable, and prove prejudicial to thoſe who drink it.——Thus much I have preſumed to ſay, in order to prevent the pernicious cuſtom, that has too long prevailed: perſons of reaſon will very likely try the experiment: 'tis on thoſe I rely and on whom it will chiefly depend to decide, which method is beſt to purſue, that guided by reaſon, long experience, and the reſult of many years practice; or the method obſtinately purſued by unreaſonable bigots, and a ſet of infatuated old women.

*The benefits ariſing from drinking Tar-water.*] Tar-water has been lately recommended to the world as a certain, ſafe, and almoſt infallible medicine in almoſt all diſeaſes; a ſlow, yet effectual alterative in cachexies, ſcurvies, chlorotic, hyſterical, hypochondrical, and other chronical complaints: and a ſudden remedy in acute diſtempers which demand immediate relief, as pleuriſies, peripneumonies, the ſmall pox, and all kinds of fevers in general: yet, though it may fall ſhort, in ſome caſes, of the character given it; it is, doubtleſs, in a multitude of caſes, of great utility: it ſenſibly raiſes the pulſe, and occaſions ſome conſiderable evacuations, generally by perſpiration, or urine, though ſometimes by ſtool or vomit: hence it is ſuppoſed to act by increaſing the vis vitæ, and enabling nature to expel the morbific humours. We ſhall here inſert, from the firſt public recommender of this liquor (Biſhop Berkeley) ſome obſervations on the manner of uſing it. Tar-water, when right, is

not paler than French, nor deeper coloured than Spaniſh white wine, and full as clear: if there be not a ſpirit very ſenſibly perceived in drinking, you may conclude the tar-water is not good. It may be drank either cold or warm; in cholicks, I take it to be beſt warm. As to the quantity in common chronical diſpoſitions, a pint a day may be ſufficient, taken on an empty ſtomach, at two, or four times, to wit, night and morning, and about two hours after dinner and breakfaſt: more may be taken by ſtrong ſtomachs. But thoſe who labour under great and inveterate maladies, muſt drink a greater quantity; at leaſt a quart every twenty four hours; all of this claſs muſt have much patience and perſeverance in the uſe of this, as well as of all other medicines, which, though ſure, muſt yet, in the nature of things, be ſlow in the cure of inveterate chronical diſorders. In acute caſes, fevers of all kinds, it muſt be drank in bed warm, and in great quantity, (the fever ſtill enabling the patient to drink) perhaps a pint every hour, which I have known to work ſurpriſing cures. But it works ſo quick and gives ſuch ſpirits, that the patients often think themſelves cured, before the fever hath quite left them.

*Biſhop* BERKLEY'S *manner of preparing Tar-water.*] Tar, two pounds; water, one gallon. Stir them ſtrongly together with a wooden rod: and after ſtanding to ſettle for two days, pour off the water for uſe. It muſt be acknowledged the tar water prepared after the directions here given, has done great ſervice in the multitude of diſorders, after many other medicines had been tried, to very little purpoſe: particularly in the ſmall-pox, fevers, ſcurvy, &c. though of the moſt inveterate kind.

*How to take off ſuperfluous hair.*] This is often advertiſed in the news-papers, and is ſold at ſo high a price, that a perſon has acquired a fortune by the ſale of it; the preparation is both eaſy and cheap, being only quick-lime and orpiment, made into a paſte with common river water; but thoſe who uſe this compoſition,

ought to be cautious how they put it on the part, and not suffer it to remain above a minute or two.

*To turn acid Cider into Vinegar.*] Cream of tartar half a pound, boil it in a quart of ſtrong white wine vinegar, and put it hot into twenty gallons of cider, which you are to ſet in the ſun a few days, and it will be excellent vinegar. The bung muſt be off.

*To make Vinegar of Beer.*] Boil a quart of ſharp beer-vinegar about eight minutes; take off the ſcum, and put therein two ounces of bay-ſalt, four of cream of tartar, and two of alum; then put it to twenty gallons of beer, and let it ſtand in the hot ſun as the cider is directed.

*The celebrated Bath Liquid for taking out Spots, Stains, &c.*] Put half a pound of ſoap boiler's aſhes into three pints of river water; let it ſtand four days (often ſtirring it), then pour off the clear water, and mix it, as you uſe it, with fuller's earth, in which a few drops of ſpirits of turpentine have been mixed: this you are to lay hot on the place, and it will ſurely take out either ſpot or ſtain.

*To clean Jewels, Pearl, &c.*] There is nothing cleans any kind of jewels like fine ſmalt and emery mixed together. Rub them well with a fine ſoft bruſh dipped in the powder. Pearls are to be waſhed with a ſtrong lee of burnt tartar.

*To boil up Plate, to look like new.*] Of unſlacked lime and alum one pound each; beer grounds two quarts: boil the plate in theſe about a quarter of an hour.

*A ſafe and ſure cure for an intermitting Fever.*] Drink plentifully of warm lemonade in the beginning of every fit, and in a few days the fever will ceaſe. Or, take twenty grains of ſal almoniac in a cup of tea, an hour or two before the fit comes on.

*How to prevent the ſmoaking of lamp oil.*] Soak your match, or cotton, in vinegar, and dry it well before you uſe it; it will then burn both ſweet and pleaſant, and give abundance of ſatisfaction for the trifling trouble you have in preparing it.

*How to make Homberg's black Phosphorus, which takes fire immediately on being exposed to the open air.*] This article, which may be made useful on sundry occasions, either at home, or abroad, is prepared with alum and wheat flour (five parts of the former to one of the latter) calcined together to a brownish, or black mass; which being powdered and set in a phial loosely stopped, in a sand heat, so as to continue glowing for some time; then removing the whole from the fire, and suffering it to cool gradually, and at last stopping the bottle close, it should be kept in a dark and dry place. A little of this powder being exposed to the open air, it at once takes fire, and appears like a glowing coal: and it is remarkable, that it may be made of any animal or vegetable substance, instead of wheat flour; but that no salt can be substituted instead of alum. This is very necessary in a family, as it constantly affords light on any occasion, day or night, when a tinder-box is not to be had.

*Another Phosphorus, by Mr. Homberg.*] This is made of one part of sal ammoniac, and two parts of lime, slacked in the air; mix these well together, and fill a small crucible with them: set this in a small fire of fusion, and as soon as the crucible is red hot, the mixture will melt, and should be stirred with an iron rod to prevent its running over. When the matter is entirely fused, pour it into a brass mortar, and, when cold, it will appear of a grey colour, and as if vitrified; if now it be struck upon with any hard body, it appears as on fire in the whole extent of the stroke; but the matter being brittle, it is proper, for the experiment's sake, to dip little bars of iron, or copper, in the melted matter in the crucible, for thus they will be enamelled as it were with the matter, and these bars being struck upon, will give the same fire, and the experiment may be several times repeated before all the matter is off. These bars must be kept in a dry place, to prevent the phosphorus upon them from running, by the moisture of the air. Both these phosphori were discovered by accident; the first, in searching for a lim-

pid oil from the common ſtercoracious matter that ſhould fix quickſilver; and the ſecond, by endeavouring to calcine ſal ammoniac with lime, ſo as to render it fuſible like wax: which end was obtained, but not the other.

*Phoſphorus*, in phyſiology, is a denomination given to all bodies which ſhine, and ſeem to burn, without having any degree of heat: and that theſe bodies owe their lucidity to the motion of the parts, ſeems evident for the following reaſons. 1. Several phoſphori are undoubtedly owing to putrefaction, as rotten wood, very ſtale meat, eſpecially veal, ſome ſorts of fiſh long kept, as oyſters, lobſters, flounders, whitings, &c. which putrefaction is the effect of a ſlow and gentle fermentation, or inteſtine motion of the parts. 2. Moſt phoſphori have their light ſo weak as to ſhine only in the dark, which ſeems to argue a leſſer degree of velocity in the parts than what is neceſſary to produce heat; becauſe this laſt degree of velocity will cauſe bodies to ſhine in open day-light. 3. Some phoſphori are the parts of animated bodies, as the cicindela or glow-worm; but all the parts of an animal are undoubtedly in motion. 4. Other phoſphori put on the appearance of flame, as the ignis fatuus, the writing of common phoſphorus made from urine, flaſhes of lightning, &c. but all flame is nothing but a kindled vapour, whoſe parts are all in motion, which may be too weak to cauſe burning, or even a ſenſible degree of heat. 5. Several of thoſe innocent lambent flames may have their matter ſo agitated, or the velocity of their motion ſo increaſed, as actually to produce heat, and burn: thus, the writing of phoſphorus on blue paper, ſufficiently rubbed, will kindle into an ardent flame, and burn the paper. 6. Phoſphori ſeem to have the eſſential nature of fire, becauſe they are ſo eaſily ſuſceptible of a burning quality from fire: thus, common phoſphorus is immediately kindled into a moſt ardent and inextinguiſhable flame, by common fire. 7. By ſtroking the back of a black horſe, or cat, in the dark, we produce innumerable ſcintillæ, or lucid ſparks; in the ſame manner, the rubbing a

piece of black cloth, which has hung in the ſun to dry, will cauſe it to throw out the particles of light which it had imbibed from the ſun; whereas, a white piece of cloth, which reflects moſt of the ſun's rays, emits no ſuch lucid ſparks in the dark. Many other reaſons might be urged to ſhow, that light of every kind is owing to one and the ſame cauſe in a greater or leſſer degree, viz. the velocity of the parts of the lucid body. Phoſphori in general ſays Lemeri, may be conſidered as ſo many ſponges full of the matter of light, which is ſo ſlightly retained therein, that a ſmall external force is ſufficient to put it in motion, and cauſe it to exhale in a lucid form. Thus the phoſphori is made of human urine, and other chemical preparations, receive ſo large a proportion of fire in their preparation, and retain it ſo well in their unctuous ſubſtance, that it may be kept there in water, for twenty years; ſo as upon the firſt laying them open to the air, they ſhall take fire, and exhale in lucid flames. Not that the fire is ſuppoſed to be fixed and quieſcent all the while in the body of the phoſphorus; for that it has a real motion all the time is evident hence, that it is ſeen in any dark place, in the ſummer ſeaſon, fulminating and emitting flames (though, with all this, it ſcarce loſes any thing of the fire) ſo that the fire is not fixed in the phoſphorus, but in a continual undulatory motion. Chemiſtry, ſays Dr. Shaw, hath ſcarce afforded any thing more ſurpriſing than the common phoſphorus. To ſee letters traced with this matter become luminous in the dark, images and the bodies of men to blaze with light, and abundance of the like experiments, performed by means of phoſphorus, muſt awaken the curioſity of thoſe who have ſeen theſe experiments, and render them deſirous of being acquainted with the method of preparing it. The preparation, even to this day, is kept as a ſecret in few hands, and the matter ſold at a very great price.——Whence we apprehend it would be no unacceptable preſent to the world, to render this commodity cheaper, and diſcover its further uſes.

*The succesful method of preparing the Phosphorus of urine is this.*] Evaporate any quantity of fresh urine over a gentle fire, to a black and almost dry substance; then with two pounds thereof, thoroughly mix twice its weight of fine sand; put this mixture into a strong coated stone long neck; and having poured a quart or two of clear water into a large receiver, join it to the long neck, and work it in a naked fire: let the heat be small for the first two hours; then increase it gradually to the utmost violence; and continue this for three or four hours successively: at the expiration of which time, there will pass into the receiver a little phlegm and volatile salt, much black and fetid oil, and, lastly, the matter of phosphorus, in form of white clouds, which either stick to the sides of the receiver, like a fine yellow skin, or fall to the bottom in form of small sand. Now let the fire go out, but let the receiver continue till all be cold, lest the phosphorus take fire on the admission of the air. To reduce these small grains into one piece, put them into a little tin ingot-mould, with water; heat the ingot to make the grains melt together; then add cold water, till the matter is congealed into one solid stick, like bees-wax; which being cut into small pieces, fit to enter the mouth of a vial, may be preserved by water, and keeping the glass close stopped. If the glass were not to be stopped, the phosphorus would turn black on its surface, and at length be spoiled. The cautions required to make this process succeed, are, 1. To evaporate the urine, while it is recent. 2. To prevent its boiling over and by that means losing the most unctuous part. 3. To let the matter afterwards ferment in the cold. 4. To mix the black matter with the sand, to prevent its melting and running over. 5. To use a stone long neck, those of earth being too porous, and suffering the phosphorus to transude sooner than pass into the receiver. 6. To have the receiver very large, and with a very long neck, to prevent its breaking and over heating, which would either evaporate the white vapour wherein the phosphorus consists, or else prevent its co-

agulating. 7. To put water into the receiver, for keeping it cool, and quenching the phosphorus as it falls to the bottom. 8. To make the fire small at first, that the long neck may be preserved, and the black matter gradually dried; which would otherwise swell and run over in a black froth. 9. Lastly, it is found necessary, that the urine for the operation be of such as drink malt liquors, rather than wine. All these circumstances being required for obtaining the phosphorus to advantage, it is no wonder that so many of those who attempted it, miscarried. This operation may be greatly shortened, by freezing and concentrating fresh urine; afterwards evaporating it with care; then digesting it in the manner above mentioned. When thoroughly digested, commit the matter, in a large quantity, to an iron pot, with an earthen head, as the chemists usually do for making spirit of harts-horn, or the spirit and salt of urine: and when, by this method, all the salt and oil are obtained, let the caput mortuum be taken out, and mixed with twice its own weight of alum. The matter may now be put into well-coated long-necks, and worked with care in a reverberatory furnace, into large receivers filled with water, and connected to the long-necks by adopters, the lower ends whereof may enter the water, as in distilling of quicksilver; the operation being continued eight or ten hours. And this is apprehended to be the best way hitherto known of procuring phosphorus to advantage. This phosphorus has been several ways disguised, so as to make it appear under various forms; sometimes as a solid, sometimes as a liquid, sometimes as an ointment, and sometimes as a running mercury. Dr Wall informs us, that Mr. Boyle, being concerned to find how small a proportion of phosphorus was afforded by urine, desired him to look out for another subject that might afford it in greater plenty. The doctor afterwards causing a piece of dry matter to be dug up in the fields where night-men empitied their carts, he observed a great number of small particles of phosphorus therein. This matter the doctor immediately carried

to Mr. Boyle, who ſet Bilgar, the chemiſt, to work upon it; but he could obtain very little phoſphorus from it, till another material was added to it in diſtillation; and then he procured phoſphorus in ſuch plenty, that, ſelling large quantities at ſix guineas the ounce, he ſoon became rich, and left England. The matter which thus fixes and increaſes the phoſphorus is apprehended to be alum, which is itſelf not only in ſome meaſure prepared from urine, but appears to afford the ſame kind of acid that phoſphorus yields by burning; for, upon its analyſis, phoſphorus appears to be a compoſition of a ſtrong acid and inflammable matter, exactly in the manner of common brimſtone, whence it may not improperly be called an animal ſulphur: and accordingly, like common brimſtone, it will burn under a glaſs bell, and afford flowers that become an acid liquor, like oleum ſulphurus per campanam, by attracting the moiſture of the air. This phoſphorus has been employed for making curious experiments, a few whereof we ſhall here exhibit from Dr. Shaw. 1. The light of this phoſphorus appears greater in vacuo than in the open air. 2. In hot weather it is obſerved to dart flaſhes of light through the water wherein it is contained, ſo as exactly to reſemble lightning; which thus darts unextinguiſhed through watry clouds and vapours. 3. Theſe flaſhes of light are not apt to kindle or burn any combuſtible matter, in which they reſemble the harmleſs kind of lightning; but in a condenſed ſtate this phoſphorus burns very furiouſly, and with a moſt penetrating fire, ſo as to melt and diſſolve metals; in which reſpect it again reſembles the more deſtructive kinds of lightning, which are found to have the ſame effects. 4. If a little piece of this phoſphorus be viewed through a microſcope, the internal parts appear in a conſtant ebullition. 5. Though the phoſphorus appears to be a kind of ſulphur, yet it it does not diſſolve in highly rectified ſpirit of wine, but communicates ſome ſulphureous parts thereto; for, if this ſpirit be poured into water in the dark, it yields a faint degree of light. 6. This phoſphorus, being

mixed with a large quantity of pomatum, makes a ſhining unguent, which may be rubbed on the hands and face, without danger of burning, ſo as to render them luminous in the dark. Many other ſurpriſing experiments may be made with this phoſphorus, which is a ſubſtance that ſeems in chemiſtry to be much ſuch a thing as the loadſtone in natural philoſophy; and its effects almoſt as odd and difficult to explain, for want of knowing the latent properties of bodies.

*To make a varniſh for Braſs, that will cauſe it to look like Gold.*] Take two quarts of ſpirit of wine, and put them into a retort glaſs; then add to it an ounce of gumbuge, two ounces of lacca, and two ounces of maſtic: ſet this in a ſand-heat for ſix days, or elſe near a fire, or you may put the body of the bolt-head frequently into warm water, and ſhake it two or three times a day: then ſet it over a pan of warm ſaw duſt. But before this varniſh is laid over the metal, let it be well cleaned. This is a good varniſh to mix with any colours that incline to red, and the amber-varniſh for thoſe that are pale.

*To make a varniſh for any thing covered with Leaf Silver.*] Firſt paint the thing over with ſize, and ground chalk or whiting; let them ſtand till they are thoroughly dry, and then do them over with very good gold ſize, of a bright colour (for there is much difference in the colour of it, ſome being yellow, and others almoſt white: the firſt is proper for gold, and the laſt for ſilver) when this ſize is ſo dry, as that it will juſt ſtick a little to the touch, lay on the leaf ſilver, and cloſe it well to the fire.

END OF THE FIRST PART.

# THE GOLDEN CABINET:

BEING THE

# *LABORATORY*,

OR

# HANDMAID to the ARTS.

CONTAINING

Such *Branches* of *Useful Knowledge*,

As nearly concerns all Kinds of People,

From the SQUIRE to the PEASANT:

AND WILL AFFORD BOTH

PROFIT and DELIGHT.

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PART THE SECOND.

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*PHILADELPHIA:*

PRINTED AND SOLD BY WILLIAM SPOTSWOOD,

AND H. AND P. RICE, MARKET-STREET.

1793.

# THE

# SCHOOL of ARTS.

## PART THE SECOND.

### *Of Drawing in General.*

OF all the polite arts, none have had ſo large a ſhare of admirers as that of Drawing, the number of them including almoſt all mankind: and no wonder, ſince it repreſents objects to us in ſuch pleaſant reſemblances, that we are apt to imagine we ſee things which we really do not. It likewiſe teaches us to imitate all the works of the Creation: it brings to our remembrance things long ſince paſt, the deeds of people and nations long ſince dead, and repreſents to us the features and reſemblances of our anceſtors for ſeveral generations. There are few arts or profeſſions to which if drawing be not the parent, ſhe muſt, at leaſt, be acknowledged a kind of aſſiſtant; all deſigns and models being executed by drawing; mathematicians, architects, and navigators, daily practiſe it; it is uſed in moſt ſtations of life, from the general who commands an army, to the common mechanic. Nor have the ladies been leſs fond of this moſt excellent art; ſeveral of whom have acquired a great degree of perfection. The public are greatly obliged to Mrs. Mariana, as well as to Miſs Smyth, and Miſs St. Laurence: the

two laſt ladies have even excelled Heckel, in the flower way; and Mrs. Mariana's moſt ſurpriſing genius has excited our utmoſt admiration. To this lady we are remarkably obliged for the invention of a fine blue colour, little inferior to that of ultramarine (of which more will be ſaid in its proper place) and only remark here, that I ſhall endeavour to find a colour to anſwer that of carmine; by which means thoſe two extravagantly expenſive articles will be leſs called for, and the worthy fraternity of colourmen have leſs to anſwer for; as they have for many yesrs impoſed, what they are pleaſed to call ultramarine on the public, at the very modeſt price of four, five, ſix or ſeven pounds per ounce; when, in fact, a better blue might have been produced for leſs than five ſhillings. And, indeed, much the ſame may be ſaid of carmine; it generally ſells from three to four pounds per ounce: I know the French carmine (which is the worſt made uſe of) at this time fetches two guineas and half the ounce. I am ſorry to ſay this laſt article is too often made an improper uſe of; which, indeed, occaſions the great demand for it; and though the fair ſex have ſpent many hours very agreeably in the polite art of painting; yet I cannot help obſerving, that it is the greateſt abſurdity to endeavour to mend the works of the Creator, by laying on a pernicious colour, that will very aſſuredly ſoon render the moſt beautiful object dull and diſagreeable. But this is too tender a point to touch ſeverely; and ſhall only add, in this place, the words of Shakeſpeare's Polonius;

*'Tis true, 'tis pity!—pity it is, 'tis true!* Humbly hoping, that the ladies of North America will diſdain European faſhions; but, above all, abandon and abhor their vices*.

*Rules to be obſerved in Drawing.*] Drawing is the repreſenting, by lines or ſhades, the form or appear-

* The Ladies in ſeveral parts of Europe are ſo fond of painting their faces, that it is even done publicly; the mother teaches her daughter this pernicious art; and the men do it as frequent as the women.

ance of any thing in nature or art, the imitation of another draught, or the expreſſing, by lines and ſhades, any deſigns conceived in the mind. And as in imitating nature, or any draught, the mind is firſt impreſſed with the form or ſhape of the figures; which by the operation of the hand, is afterwards expreſſed by lines, it will appear how neceſſary it is, that the mind ſhould be frequently uſed in a curious obſervance of what is propoſed to it, by which uſe it will conceive more fully and juſtly of objects, and the hand will delineate, with the greater eaſe and exactneſs, what is thus ſtrongly impreſt on the memory. In order to arrive at perfection, it is neceſſary to underſtand what is good and beautiful in a draught; in which knowledge the mind will make a quick progreſs, by comparing prints and draughts together. 'Tis a rock on which many painters have ſplit, they have ſatisfied themſelves with a bare imitation of bad pieces, without improving their genius, or acquiring a capacity to diſcover what are beauties, and what defects. Our ideas, in ſome meaſure, ought to ſerve us for a model, and if we would improve theſe, we muſt frequently view the performances of others; we ought to be nice and critical in obſerving ſuch as are correct and good; we ſhould meditate on every print and draught we ſee, make neceſſary reflections on them, and labour to fix in our minds a remembrance of their beauties, the freedom and boldneſs of the out-line, and the proportion of the ſeveral parts. If the judgment be well formed, the young practitioner will be enabled to make a much greater improvement than he can poſſibly do, if he proceeds in practice, without increaſing in judgment. The labour of the hand muſt ſecond and ſupport that of the brain; 'tis impoſſible to become an able artiſt, without making the art habitual, and a perfect habit is not to be gained, without a great number of acts, and without conſtant practice. In all arts, the rules of them are to be learned in a ſhort time; but the perfection of them is not acquired without practice and diligence. It is a true maxim, that lazineſs never produced any thing that was excellent; to be perfect

in drawing, 'tis neceſſary that the hand ſhould be improved in practice, and the mind in judgment every day. Morning is the beſt and proper part of the day for buſineſs; employ it therefore in the ſtudy and exerciſe of thoſe things which require the greateſt pains and application. The firſt care ſhould be employed in in imitating ſtraight and curved lines, ſquare, round, regular, irregular, and inanimate figures, alſo parts or out-lines of flowers, &c. &c. This will be a good platform on which to erect the building; for by this labour you will attain a facility of hand, a freedom and exactneſs of drawing lines, and a cuſtomary exerciſe of patience; qualifications, without which no one can apply himſelf with pleaſure and diligence in the exact imitation of the moſt difficult objects, which will require a longer time, and more art in copying. The circumferent ſtrokes are called out-lines; and the excellency of a good out-line conſiſts in freedom, boldneſs, and the exact proportion of all its parts. Always begin your copy at the top; and draw the right-ſide of the figure firſt, for by that means the ſtrokes are always expoſed to the eye; the reſt will follow more naturally, and give leſs trouble. Be content for ſome time, to practiſe after a good out-line, without attempting at finiſhed pieces, or even without ſhading your own draught: ſketch your out-line at firſt with ſlight touches, and faint, that the amendment of it, when neceſſary, may be the better performed, without appearing to be re-touched: endeavour after the moſt exact imitation in every ſtroke; and when you correct the out-line, by taking away a little of ſome parts, and ſwelling others, mind that you loſe nothing in the freedom and boldneſs of it. Compare your copy frequently with the original, carefully obſerving what is amiſs, that a fault may not eſcape you without correction, and that in the next draught you make after the ſame original, you may avoid thoſe errors; for you are not to make new tranſitions from one original to another, till you have obtained in ſome meaſure a proficiency in the firſt. Many ſketches of the ſame figure, in every one endeavouring

to exceed the former, is the fureſt way of practice. Be ſlow in your firſt operations; a conſtancy of practiqe will be ſure to make your hand expeditious; learners muſt overcome their paſſions by the exerciſe of patience; they muſt proceed ſlowly and prudently in their firſt attempts, and make it their care rather to perform well, and to ſecure every ſtroke, and by that means make one good draught, than in a heedleſs manner to hurry over a number of bad ones. The ſame may be ſaid with regard to moſt other arts. Before you begin your work, and whilſt you are at it, view your original with cloſe attention; divide it in your mind in ſeveral parts; obſerve the length, the breadth, and the ſimilitude of each part; conſider their proportion to each other, and to the whole; the diſtances from one part to the other, and what parts lie parallel to each other. After you have done your copy, and your mind perhaps been employed about other affairs, you ſhould view them afreſh, for many faults will then appear, that were not diſcovered before; and whatſoever pains you beſtow on frequent reviewing and comparing the original with your own copy, will not only ſerve to perfect you in that particular draught, but will alſo improve you in the knowledge of lines, draughts, and proportions, and by practiſing in that method, you will be the ſooner qualified for the more nice and neareſt imitations. The out-lines muſt be drawn in a flowing, gliding manner, large and ſmooth, for when they are too ſtraight, they appear ſtiff; but, when performed in the manner here directed, they have the reſemblance of life and motion. What other inſtruments are neceſſary, will be found in the following pages; and ſhall now direct to the

*Proper Materials for Drawing.*] Theſe are either black-lead pencils, or black-lead fixed in a portcrayon, charcoal, red, black, or white chalk, paſtils or crayons, pens, or hair-pencils, and Indian-ink. Black-lead is as proper, in the beginning, to practiſe after the plain lines, &c. as any other material: the ſtroke it makes being ſmooth, will be more pleaſing than what is effected by charcoal or crayons. It muſt have a fine point, and

accuſtom yourſelf to hold it long in your hand, that the end of your fingers may be at a much greater diſtance from the point, than they are from the nip of a pen in writing, and form your ſtrokes with light gentle touches, by which means you will obtain a greater command of hand, and your out-line will be more free and bold. Pens are ſometimes uſed in ſhading draughts, by hatching them with croſs ſtrokes: but this is better done with hair pencils and Indian-ink, which is uſed in the ſame manner as water-colours. The ſhades in hatching are effected by lines, and appear like the ſtrokes which ſhade an engraved print: but contrary to this, is uſing the hair-pencil and Indian-ink, there do not appear any lines, but the ſhades look like thoſe in a mezzotinto print.

*Of Lights and Shadows.*] It is the artful management of lights and ſhades that gives the appearance of ſubſtance, roundneſs, and diſtance, to whatever bodies we repreſent. Imagine you draw a circle on a piece of paper; conſider this circle, when it is firſt formed, or fill it up with any even colour whatever, and it will appear to be a body with a round circumference, and flat ſides: but, if you let the ſtrongeſt of the colour remain in the middle, and gradually weaken it towards the circumference, it will, by this means, pleaſingly deceive the ſight, and receive a convex appearance like a ball or globe. Wherever the vivacity of colour is ſtrongeſt, that part of the object catches the ſight firſt, and appears neareſt to it: whereas its weakneſs and goings off are more and more broken and faint, and ſeem to fly farther from the ſight. In rounding the parts of any object, the extremities in turning muſt loſe themſelves inſenſibly and gradually, without precipitating the light all of a ſudden into the ſhadows, or the ſhadows into the light; but the paſſage of the one into the other muſt be eaſy and imperceptible; that is, the ſhadow muſt be ſoftened gradually, till it loſes itſelf in light. Objects that are painted light, muſt have a ſufficient breadth of ſhadow to ſuſtain them; and dark bodies muſt have a ſudden light behind, to detach

them from the ground, or from those objects that are placed behind them, otherwise they will confusedly appear, as sticking upon each other; whereas the opposition of shade to a light object, and of light to a dark one, gives a projection, and separates them from other bodies. The nearer any object is to the eye, it is seen so much the stronger and plainer; the sight is weakened by distances; and the more remote any object is, 'tis seen in a more imperfect manner; therefore these objects that are placed foremost to the view, ought to be more finished than those that are cast behind; and they should have such a relative dominion over each other, that as the object, by its heightenings, causes others to retire more backward, so the same object must be chased, and made to appear farther from the sight, than others which are more strongly illuminated. It is not sufficient that remote objects be only coloured in a more faint and languid manner, but, according to their distance and parts, must appear more or less confused; the eye does not minutely discover what is separated from it. At the length of a field or street, we descry human figures, but the features of their faces, and the folds of their garments, are imperceptible to us; and so the innumerable leaves that grow on distant plantations, appear to the sight but one mass.

*Directions for mixing and making Colours.*

YELLOW. GUMBUGE is a most beautiful yellow; by putting water to a lump of this, it soon dissolves, and is made paler or deeper to your liking: but no gum-water is to be used, it being a gum itself; nor should this yellow be used on prints designed to be varnished, for the varnish takes this colour quite off. This is sold cheap, and may be had at any druggist's.

*Gall-stone* is a fine transparent colour of an orange tinge, very fit to glaze with, or to shade the yellow with.

*Dutch-pink* is another yellow, and should be used when prints are designed for varnishing.

GREEN. *Diſtilled-verdigriſe* is a bright ſhining green, to be uſed very ſparingly, and with judgment: but the addition of a little gumbuge makes it look far pleaſanter. This is bought in phials, ready prepared: the colourmen tell you, it is very troubleſome to make: and no doubt, ſell it dear.—But more of this in its proper place.

*Sap Green* is a lump diſſolved in water: and is uſed with moſt advantage when plenty of water is put to it: otherwiſe it is very dark and unpleaſant.

*French-Berries*, are to be diſſolved in water, and afford but an odd kind of green, unleſs mixed with ſome other article. Gum water is not to be uſed with theſe berries: or with the Sap-green above-mentioned.

*Indigo and Gumbuge*, mixed together, make a very agreeable green: and you may ſuit it to your liking, as you put more or leſs of the gumbuge: but judgment and fancy muſt direct what tinge is moſt agreeable in this and all other colours.

BLUE. *Ultramarine*, is the fineſt of all blues; it is ſold extravagantly dear; but indeed a very little goes a great way, when it can be procured of the right ſort: which is indeed rarely to be met with, notwithſtanding the high price it bears.

*Smalt*, if very fine, is a good blue: of itſelf it is but a heavy colour, difficult to lay ſmooth and be tranſparent: on which account care and judgment are required in uſing it.

*Indigo*, a deep heavy blue, proper for a dark ſhade, &c.

*Verditer*, a fine ſky-blue; but it is to be uſed ſparingly, and with diſcretion.

*Pruſſian Blue*, is a fine blue, if laid on very thin, and proper to ſhade other blues with: but it is beſt when uſed in oil-colours.

CRIMSON and RED. *Carmine*, is the fineſt of all reds; it affords a bright and beautiful colour, when good, and flows eaſily in the pencil; and with the ſame colour, or lake, you may make the ſhades as ſtrong as you pleaſe.

*Lake*, is likewiſe a fine tranſparent colour, and is, when of a good kind, preferable to ſome carmine.

*Red-Lead*, a powder, if fine, affords a good colour; but it being of a heavy nature, care muſt be taken that it be not laid on too thick, which would prevent its being tranſparent: it is likewiſe apt to turn blackiſh, unleſs it be well cleanſed and refined. See waſhed red-lead.

*Vermillion*, we may ſay the ſame of as of the red-lead.

ORANGE. Lay firſt a tint of gumbuge, and over that ſome red lead, or carmine, or lake, either will do.

PURPLE. *Carmine and Ultramarine*, mixed together, make the fineſt of all purples.

The above colours, by blending two together, may be altered to quite another tint: though in doing this, no certain rule can be laid down, but fancy, with judgment, muſt direct. In uſing the colours, great care ſhould be taken to lay the firſt colour on very thin, or pale, by which means the ſhade will appear ſtronger, and the whole more beautiful. In moſt caſes, if the white paper was left in the lights of the object, whether flower or figure, and only the ſhades to be coloured, would be beſt: or, ſhould the white paper be thought to appear in too glaring a light, then (afterwards) a very thin tint may be laid on. And this caution I would adviſe to be univerſally obſerved, to lay on all colours very thin at firſt, it being eaſy to make the light parts deeper; but the damage is not eaſily repaired, when the colour is laid on too thick at firſt.

*Some neceſſary Remarks on Colours, &c.*] As the the preparation of diſtilled verdigriſe is pretended to be both tedious and troubleſome, I will here put it in the practioner's power to make his own; which, if my directions are followed, I will anſwer for its being full as good, if not better, than what is ſold at the colour-ſhops.

Diſtilled verdigriſe, uſed in colouring prints, and in the preſent mode of painting, is a liquid, and which I have before mentioned, as ſuch, under the article of

greens. You are to procure an ounce of diſtilled verdigriſe, in the lump, which will coſt about eight-pence; this you are to bruiſe ſmall, and then put it into twelve ounces of the beſt white wine vinegar, which muſt not only be ſtrong, but very fine; ſhake it well in the bottle, at firſt putting in, and let it ſtand in the ſun, or ſome place that is warm, for a day or two, often ſhaking it, and it will then be fit for uſe. This is the very extraordinary trouble of making the liquid diſtilled verdigriſe, and for which the venders are ſo well paid. They, indeed, add about a ſpoonful of brandy to the above quantity; which can only be to diſguiſe it, as it cannot be the leaſt ſervice: in common writing ink, brandy is ſaid to prevent its turning mouldy, &c. but I have uſed the article above mentioned both with and without the brandy, and kept it many months, and could not perceive the difference; but that is the preparation of the ſhops. You are, however, to remark, that this liquid is beſt kept on the fine powder that you will perceive at the bottom of the bottle, being no way troubleſome, and will ſoon precipitate, and be fine for uſe: it being beſt to pour off a very ſmall quantity into a bottle or gallipot, when you are uſing it. A little of this goes a great way: it flows well in the pencil, and may be uſed with a pen, even as well as common writing ink, if required. It is a very ſhining green, but may be made pleaſant and agreeable, by mixing more or leſs gumbuge with it, according as your fancy directs, or circumſtances require.

I ſhould have mentioned ſaffron among the yellows, as being the higheſt of all, and appearing fine and delightful; but as this colour is very apt to fly, I muſt own, I make very little uſe of it; and not at all, without being well loaded with gum; nor will it bear varniſh by any means.

As a good blue is the moſt difficult to procure, eſpecially at an eaſy price, I will here inſert a very valuable one; I don't give it as an invention of my own, but acknowledge we are indebted to the ingenious Mrs. Ma-

riana for it, as I have before hinted; and it is thus prepared, according to her directions.

"Take, says she, half an ounce of the finest Litmus: it must be powdered very fine; Prussian-blue half a drachm, powdered very fine likewise: eight ounces of the clearest small beer wort, while it is running: the above articles are to be thrown into the wort while warm; they are then to be put into a new earthen vessel, that is extremely well glazed, and remarkably sweet and clean: to be set over a moderate fire till it boils, then to be taken off, stand till cold, and it is to be kept for use. N. B. If this is made in summer time, when corn is near ripe, throw in, when cold, half a scruple of those fine blue flowers that are often to be found among wheat, as it grows in the fields: it will be a most heavenly blue; but great care must be taken that it touches not the least acid, for that spoils all."

Mrs. Mariana gives great caution, to beware that acid interferes not in the above curious colour: but the greatest difficulty seems to me to know how to prevent it.——For, supposing that the wort in itself had no acid property when first made use of; yet in a hot season it would no doubt be not only acid, but even very sour, a few days after making, and thereby become useless, if so very trifling an acid, as she observes, would deprive it of its beauty; and which I myself have often experienced, and found to be true. In fact, the colour is truly beautiful, and I have generally succeeded in the preparation when I observed the following cautions, viz. First, that the earthen vessel (for no other will answer the end) be well glazed and clean; I then throw in a large lump of fine soft chalk, add as much water thereto as will fill the vessel, and then set it on a slow fire 'till it is very hot; I afterwards cover it up and let it remain three or four hours, and then clean it very well. Secondly, I procure my new wort after the following manner: having obtained about four ounces of the finest pale malt, I put this into a tea-pot, without being either ground or even bruised; and put about twelve

ounces (three quarters of a pint) of fine soft river water, boiling hot, thereto; I let this stand near the fire, so as to keep it warm, an hour, afterwards I pour it off, and it will be fit for the use according to the directions of Mrs. Mariana. It is to be observed, that the water, of which the wort is made, ought to be of the most pure kind, very soft, and extremely fine; for much depends on it. And 'tis not to be wondered at, that many have miscarried in making this curious article, since they all procure the wort from any one that happens to be brewing. I must own I have made an extreme good blue with only the Litmus (it is best known by the name of Lacmus, and sells for about four-pence the ounce) being powdered and gently boiled in the fine wort above-mentioned; it will soon jelly and grow hard, and will keep in that manner for a year, or more; it is made liquid immediately, by only dipping the pencil in fair soft water, and touching it as you do Indian-ink.

I am not in this place going to treat of the common black writing ink; perhaps it might well answer the end of those who make and deal in it, to be better acquainted with the easy preparation of wort and litmus boiled together. This, without much care, trouble or expence, will make a good blue, that will flow in the pen better than the ink commonly made use of; and as to its growing soon hard (and more so, if long boiled, and left to cool in very small quantities) it is a property that makes it far more valuable, especially for those who travel; because it will keep, in a dry place, a long time, and soon liquefy again. In one word, it will make the best black writing ink in the universe, with the addition of some bruised galls, &c. but in this case, no gum is to be used.—It may be remembered, that all good blacks should be raised from blues.

Mariana's fine blue has got discredit by some, from a circumstance little thought of. I remember lady Ferrers, after saying a great deal in its favour, complained, that it would not hold its colour. Know then, that a great part of the fine writing paper has what the mak-

ers call an alum size laid on it, which intirely spoils this fine tender blue; and so it does a sort of mixture—too often sold for ultramarine. But paper, sized after this manner, is soon known, by only putting the tongue thereto.

I make a blue that I find of good service after the following manner: having procured some of the finest Prussian-blue, I powder it, and grind it well with a strong gum water, made of the clearest sort of gum-arabic. After it is sufficiently fine, I add some flake white thereto, which I also grind well in; and by adding more or less of the white, I make it lighter or darker, to my fancy. But, indeed, I generally keep three or four degrees, which I make up into small squares, and use it in the same manner I do the Indian-ink.

There is a sort of brown, much used by those who colour prints, which is quite transparent, and to be had in all places: procure a small quantity of the most mild pale tobacco; put a very little of this to a spoonful of common water in a cup or gallipot, and in a few minutes you will have a good brown colour, that suits on many occasions; and it may be made quite dark, by adding more of the leaf, or by putting hot water to it. Gum-water is not to be used with this article, unless it be very weak. I know an objection will be made against the tobacco on account of its smell; but it is a mistake, for the smell goes off immediately: indeed the colour-men don't approve of it; and I well know the reason of their dislike; it would be the best of browns, if they could contrive to disguise it, and sell it a great price, as they do many of their other articles, which in themselves are very trifling.——Pray how does their Gall-stone, &c. smell?

Rose-pink is no bad colour, if of a good sort: this I manage as I do the Prussian-blue, and keep it dry in a cake; two sorts will be sufficient, one lighter than the other; which is made by the addition of the flake-white, as directed in the blue.

Black ſhould never be mixed with any colour, becauſe it makes it look diſagreeable and dirty. Indeed I ſeldom uſe any other black than Indian-ink, nor other white than flake-white, though I know white-lead is often uſed; but the other is beſt.

Waſhed red-lead is a fine colour, and comes reaſonable; nor is the trouble much to prepare it. You are to procure half a pound of the fineſt red-lead, which muſt be finely powdered: put this into a mug, and ſtir it about well in near a quart of clear ſoft water; pour the water off into another mug, ſtir it about, and again pour it off; ſtir it, and pour it off again, and do in this manner ſix or ſeven times, always obſerving to pour as long as it will run, and leave the powder that precipitates to the bottom of each mug (which will grow leſs and leſs) to dry; and though, in the whole, you will not have above half a drachm; yet, if the red-lead was good, you are ſure of a fine colour left at the bottom of each mug, which will ſoon dry, and may be ground with gum-water, and kept in ſhells for uſe.

Vermillion may ſometimes be improved in the ſame manner; but as there are different preparations of it, and ſome of them will not anſwer this operation, I would by no means adviſe it.

Logwood boiled in clear ſtale beer, and a little fine Brazil-wood added thereto, makes a tolerable purple, which remains liquid.

But a good purple, intended for keeping, is to be made thus: new wort one pint, litmus one ounce, fine Brazil, bruiſed, one ounce, let theſe boil over a ſlow fire, about half an hour, in a clean new mug, well glazed. When cold, ſtrain it off, and keep it for uſe. If this is left in ſmall quantities, it will be apt to jelly and grow dry: but, if deſigned to be kept liquid, add a little ſpirits of wine thereto, and keep it in a large bottle.

A delightful red, not inferior to carmine, is made thus; ſpirits of wine eight ounces, of the fineſt lake one drachm, ripe barberries half an ounce, dragon's-blood, of the reddeſt ſort, one drachm, fine Brazil-wood a quarter of an ounce; this is to remain ſeven or

eight days in the ſun, or moderate heat, in a phial well corked; you are to ſhake the bottle often; and after you ſee the colour very high and delightful, which it will be in little more than a week, let it ſettle, and pour it off for uſe. It ſhould be in a clear flint glaſs bottle, that you may the better obſerve the colour. After ſtanding ſome time, and you find it very fine, you may put a few drops into a ſhell, or on a Dutch-tile, ſmooth glaſs, &c. which will ſoon dry: you may then rub into it a little clear gum water, which gives it a better body, or it may be uſed liquid in many caſes.

The colours I have already mentioned, are ſufficient, by being blended together, to form a ſufficient variety for moſt purpoſes, and for doing which I can lay down no certain rule, but muſt leave it to the fancy and judgment of the practitioner.

*To make a Varniſh for Silver.*] Melt, in a well glazed pipkin, ſome fine turpentine, and put in three ounces of white amber, finely powdered (more or leſs, according to the quantity your work will require) put it in by little and little, keeping it continually ſtirring, adding by degrees, ſome ſpirit of turpentine, till all the amber is diſſolved: then add to it an ounce of Sarcocolla well beaten, and an ounce of gum elemi well levigated, adding now and then a little ſpirit of turpentine, till all is diſſolved: do this over a gentle fire, and keep it conſtantly ſtirring. This varniſh is to be uſed warm, and hardened by degrees in an oven, whereby it will look like poliſhed ſilver.

*Manner of Engraving on Copper, &c.*] This is performed with a graver on a plate of copper, which being well poliſhed, is covered over thinly with virgin-wax, and then ſmoothed while warm, with a feather, ſo that the wax be of an equal thickneſs on the plate: on this the draught or deſign, done in blacklead, red chalk, or ungummed ink, is laid with the face of the drawing on the wax: then they rub the back ſide, which will cauſe the whole deſign of the drawing to appear on the wax. The deſign, thus tranferred, is traced through the copper, with a point, or needle: then beating the plate,

and taking off the wax, the ſtrokes remain to be followed, heightened, &c. according to the tenor of the deſign, with the graver, which muſt be very ſharp, and well pointed. In the conduct of the graver conſiſts almoſt all the art, which depends not ſo much upon rules, as upon practice, the habitude, diſpoſition, and genius of the artiſt, the principles of engraving being the ſame with thoſe of painting; for if the engraver be not a perfect maſter of deſign, he can never hope to arrive at any degree of perfection in this art. In conducting the ſtrokes or cuts of the graver, he muſt obſerve the action of the fingers, and of all their parts, with their out-lines; and remark how they advance towards, or fall back from his ſight, and then conduct his graver, according to the riſings or cavities of the muſcles or folds, widening the ſtrokes in the light, and contracting them in the ſhades; as alſo at the extremity of the out-lines, to which he ought to conduct the cuts of the graver, that the figures or objects repreſented, may not appear as if they yawn; and lightening his hand, that the out-lines may be perfectly ſound, without appearing cut or ſlit: and altho' his ſtrokes neceſſarily break off where a muſcle begins, yet they ought always to have a certain connection with each other, ſo that the firſt ſtroke ſhould often ſerve to make the ſecond, becauſe this will ſhow the freedom of the graver. If hair be the ſubject, let the engraver begin his work by making the out lines of the principal locks, and ſketch them out in a careleſs manner, which may be finiſhed at leiſure with finer and thinner ſtrokes to the very extremity. The engraver muſt avoid making very acute angles, eſpecially in repreſenting fleſh, when he croſſes the firſt ſtrokes with the ſecond, becauſe it will form a very diſagreeable piece of tabby like lattice work, except in the repreſentation of ſome clouds, in tempeſts, the waves of the ſea, and in repreſentations of ſkins of hairy animals, and leaves of trees. So that the medium between ſquare and acute ſeems to be the beſt and moſt agreeable to the eye. He that would repreſent ſculpture, muſt remember that, as ſtatues, &c. are moſt

commonly made of white marble, or ſtone, whoſe colour does not produce ſuch dark ſhades as other matters do, have no black to their eyes, nor hair of the head, and beard flying in the air. If the engraver would preſerve one quality and harmony in his works, he ſhould always ſketch out the principal objects of his piece before any part of them are finiſhed. The inſtruments neceſſary for this ſort of engraving are, beſides a graver, a cuſhion, or ſand bag, made of leather, to lay the plate on, in order to give it the neceſſary turns and motions; a burniſher made of iron or ſteel, round at one end, and uſually flattiſh at the other, to rub out ſlips and failures, ſoften the ſtrokes, &c. a ſcraper, to pare off the ſurface, on occaſion; and a rubber of a black hat, or cloth rolled up, to fill up the ſtrokes, that they may appear the more viſible.

*Method of Etching on Copper, &c.*] Etching is a method of engraving on copper, in which the lines, or ſtrokes, inſtead of being cut with a tool or graver, are eaten in with aquafortis: and this is done with more eaſe and expedition than engraving; it requires fewer inſtruments, and repreſents moſt kind of ſubjects better and more agreeable to nature, as landſcapes, ruins, grounds, and all ſmall faint, looſe, remote objects, buildings, &c. The method of etching is as follows: chooſe the copper plate as directed for graving, and furniſh yourſelf with a piece of ground, tied up in a bit of thin ſilk, kept very clean, to be laid upon the plate when both have been warmed; proper needles to hatch with on the ground; a pencil or bruſh to wipe away the bits of ground which riſe after hatching; a poliſher; two or three gravers; a pair of compaſſes, to meaſure diſtances and draw circles; a ruler, to hatch ſtraight lines; green wax, to make the wall round the edges of the plate, to contain the aquafortis; an oil ſtone; a bottle of aquafortis; ſome red-lead, to colour the back ſide of the copy; a ſtift, and a hand-vice, to hold the plate over the candle. To make the ground, take three ounces of aſphaltum, two ounces of clean roſin, half an ounce of burgundy-

pitch, three ounces of black wax, and three ounces of virgin's wax: let all these be melted in a clean earthen pipkin over a slow fire, stirring it all the time with a small stick: if it burn to the bottom, it is spoiled. After the ingredients are well melted, and it boils up, put it into a pan of fair water: and before it be quite cold, take it out, and roll it into small lumps to be kept from dust: this ground is what others call the varnish. The next thing is to clean the plate to receive the ground: take a piece of lifting, roll it up as big as an egg, tie it very tight, so as to make it a rubber, and having dropt a small quantity of sweet oil, and added a little powder of rotten stone on the plate, rub it with this ball, till it will almost show your face. Then wipe it all off with a clean rag, and after that, make it quite dry with another clean rag, and a little fine whiting. The next thing is to lay on the varnish: to do which aright you must take a hand-vice, and fix it at the middle of one part of the plate, with a piece of paper between the teeth of the hand vice and the plate, to prevent the marks of the teeth: then laying the plate on a chafing dish, with a small charcoal fire in it, till the plate be so hot, that by spitting on the backside, the wet will fly off; rub the plate with the ground tied up in silk, till it be covered all over; and after that daub the plate, with a piece of cotton wrapped up in silk till the ground be quite smooth, keeping the plate a little warm all the time. The varnish being thus smoothed upon the plate, it must be blacked in the following manner: take a thick tallow candle that burns clear, with a short snuff, and having driven two nails into the wall, to let it rest upon, place the plate against the wall with the varnish side downward, and take care not to touch the ground with your fingers: then taking the candle, apply the flame to the varnish as close as possible, without touching the varnish with the snuff of the candle, and guide the flame all over it, till it becomes perfectly black. After this is done, and the plate dry, the design is traced with a needle through the varnish, and a rim or border of wax is raised round

the circumference of the plate; and then the artiſt has a compoſition of common varniſh and lamp-black, made very thin, wherewith he covers the parts that are not to be bitten, by means of a hair pencil. And he is every now and then covering or uncovering this or that part of the deſign, as occaſion may require; the conduct of the aquafortis being the principal concern, on which the effect of the print very much depends. The operator muſt be attentive to the ground, that it does not fail in any part, and where it does, to ſtop up the place with the above compoſition. The plate is defended from the aquafortis every where, but in the lines or hatches cut through it with the needle, through which the water eats into the copper to the depth required; remembering to keep it ſtirring with a feather all the while, which done, it is to be poured off again. Single aquafortis is moſt commonly uſed; and if it be too ſtrong, mix it with vinegar, otherwiſe it will make the work very hard, and ſometimes break up the ground: the aquafortis having done its parts, the ground is taken off, and the plate waſhed and dried; after which nothing remains for the artiſt but to examine the work with his graver, to touch it up, and heighten it where the aquafortis has miſſed. And laſtly, it is to be remembered, that a freſh dip of aquafortis is never given, without firſt waſhing out the plate in fair water, and drying it at the fire.

*Different Ways of making Carmine.*] It is extracted from cochineal, by means of water, wherein chouan and antour have been infuſed: ſome add rocou, but this gives too much of the oval caſt. Others make carmine with brazil-wood, fernambouc and leaf gold, beat in a mortar, and ſteeped in white-wine vinegar: the ſcum ariſing from this mixture, upon boiling, when dried, makes carmine: but this kind is vaſtly inferior to the former. There is another carmine, made of brazil-wood and fernambouc. But a ſort, that is too often met with, is prepared from ſhreds of ſuperfine ſcarlet cloth, infuſed in ſpirits of wine.

*The preparation of Ultramarine.*] This is prepared

from lapis lazuli, by calcination: but the German lapis lazuli does not anſwer well in this proceſs, and diſcovers itſelf by calcining eaſier than the African or Aſiatic, and turning greeniſh. The oriental kind calcines to a finer blue than it naturally has, and retains the colour for ever. After calcining the ſtone in a clear fire of charcoal, they grind it to an impalpable powder on a porphyry, and then mixing it up in a paſte, compoſed of pitch, wax, and oil, they work it about with the hands: and finally, kneading this in a veſſel of clear water, as the powder ſeparates from the viſcid matter, it ſinks to the bottom: when all that is perfectly fine in this is worked out, they let the water be drained off and dry the powder for uſe. What remains embodied in the paſte is afterwards ſeparated, and makes a worſe kind than the former. Ultramarine muſt be choſen of a high colour, and well ground, which may be known by putting it between the teeth, and if it feel gritty, it is a ſign it has not been well ground. To know whether it be pure and unmixed, put a little of it into a crucible, and ſo heat it red hot; and if the powder has not changed its colour after this trial, it is certainly pure; on the contrary, if there be any change, or any black ſpecks in it, then it has been adulterated. There is alſo a ſpurious ſort, commonly called Dutch ultramarine, which is only fine ſmalt well ground and pulveriſed: and this ſort is too often ſold at a moſt extravagant price.

*To ſoften Ivory and other Bones.*] Lay them for twelve hours in aquafortis, and then three days in the juice of beets, and they may be worked into any form. To harden them again, lay them in ſtrong vinegar. Dioſcorides ſays, that by boiling ivory for the ſpace of ſix hours with the root of mandragoras, it will become ſo ſoft, that it may be managed as one pleaſes.

*To whiten Ivory.*] Lay it in quick lime, and pour a little water over it, but not too much that the heat may not be too great, leſt it ſcale and become brittle.

*Staining and marbling of Ivory.*] 1. Of a fine coral red: make a lye of wood-aſhes, of which take two

quarts, pour it into a pan upon one pound of brazil; to this add one pound of alum; boil it for half an hour: then take it off, and put in the ivory or bone, and the longer either of these continue in the liquor, the redder they will be. 2. Of a fine green: take two parts of verdigrise, and one part of sal ammoniac: grind them well together, pour strong white wine vinegar on them, and put your ivory into this mixture, let it be covered till the colour has penetrated, and as deep as you would have it. If you would have it spotted with white, sprinkle it with wax; or if you would have it marbled, cover it with wax, and scrape it off in veins, having all the lines uncovered which you desire to have stained. 3. Of black: take litharge and quick-lime, of each an equal quantity; put them in rain water over the fire till it begins to boil, and in this put the bone or ivory, stirring them well about with a stick; and afterwards when you see the ivory receive the colour, take the pan from the fire, stirring the ivory all the while till the liquor is cold. 4. Marbling upon ivory is performed thus: melt bees wax and tallow together, and lay it over the ivory, and with an ivory bodkin open the strokes that are to imitate marbling: pour the solution of some metal on them, and when it has stood a short time, pour it off: when it is dry, cover the strokes again with the wax, and open some other veins with your bodkin for another metallic solution; and this repeat to the number of colours you design to give it. The solution of gold gives it a purple; of copper, a green; of silver, a bad black; of iron, a yellow and brown. By this method you may also imitate tortoise-shell, and several other substances on ivory.

*The true Method of making Sealing-wax, &c.*] Take one pound of bees-wax, three ounces of fine turpentine, olive oil, and rosin (finely powdered) of each one ounce: when they are well melted, and dross taken off, put in an ounce and a half of vermillion, or red lead, finely ground, and stir them together till they are well incorporated, when this mixture grows a little cool, roll it into sticks, or in any other form you would have it.

If you would have it black, inſtead of vermillion, or red-lead, put into it lamp-black—The ſoft, red, and green wax, uſed in large ſeals to ſome of our law writings, are thus made: melt bees wax over a gentle heat; with ſuch a proportion of Venice turpentine as, when cold, will give it the due conſiſtence: this is determined by repeated trials; firſt putting in but little turpentine, and afterwards more and more, till by dropping a piece upon a marble to cool, it is found of the true conſiſtence. They then colour it with vermillion, or red-lead, or with verditer, or whatever colour they pleaſe, the mixture in this ſtate, receiving any.

*To imitate Fruit in Wax.*] Take the fruit, and bury it half way in clay; oil its edges, and that part of the fruit which is uncovered: then nimbly throw on it tempered alabaſter, or plaiſter of Paris, to a conſiderable thickneſs. When this is grown dry and hard, it makes the half mould; the ſecond half of which may be obtained in the ſame manner. The two parts of the mould being joined together, a little bees wax melted and brought to a due heat, being poured through a hole made in a convenient part of the mould, and preſently ſhook therein, will repreſent the original fruit.

*How to repreſent the Face, &c. in Wax* ] The repreſentation of the face, &c. of perſons living, or dead, is done by applying plaiſter of Paris in a kind of paſte, and thus forming a mould containing the exact repreſentation of the features. Into this mould melted wax is poured, and thus a kind of maſks are formed; which being painted and ſet with glaſs eyes, and the figures dreſſed in their proper habits, they bear ſuch a reſemblance, that it is difficult to diſtinguiſh between the copy and the original.

*Of Varniſhes in general.*] There are ſeveral kinds of varniſhes in uſe; as the ſiccative or drying varniſh, made of oil of aſpin, turpentine and ſandarach melted together. White varniſh, called alſo Venetian varniſh, made of oil of turpentine, fine turpentine and maſtic. Spirit of wine varniſh, made of ſandarach, white amber, gum elemi and maſtic; ſerving to gild leather, picture

frames, &c. withal. Alſo the gilt varniſh, china varniſh, common varniſh, &c.

*To make white Varniſh.*] Take gum ſandarach, of the cleareſt and whiteſt ſort, eight ounces; gum maſtic, of the cleareſt ſort, half an ounce; of ſarcocolla, the whiteſt, three quarters of an ounce; Venice turpentine, an ounce and a half; benzoin, the cleareſt, one quarter of an ounce; gum animæ, three quarters of an ounce; let all theſe be diſſolved, and mixed in the manner following: Put the ſarcocolla and roſin into a little more ſpirits than will cover them to diſſolve: then add the benzoin, gum animæ, and Venice turpentine, into either a glaſs or glazed earthen veſſel, and pour on as much ſpirits as will cover them an inch: then put the gum maſtic into a glaſs or glazed veſſel, and pour ſtrong ſpirits upon it, covering it alſo about an inch thick, to diſſolve it rightly: then put your gum elemi in a diſtinct veſſel as before, and cover it with ſpirits to diſſolve. For this purpoſe, you need only break the roſin a little, and powder the gum animæ, ſarcocolla, and benzoin. Let all ſtand three or four days to diſſolve, ſhaking the glaſſes, &c. two or three times a day, and afterwards put them all together into a glazed veſſel, ſtirring them well, and ſtrain the liquor and gums gently, beginning with the gums, through a linen cloth. Then put it into a bottle, and let it ſtand a week before you uſe it, and pour off as much of the clear only, as you think ſufficient for preſent uſe.

*The white Amber Varniſh, according to Mr. Boyle.*] Take white roſin four drachms, melt it over the fire in a clean glazed pipkin; then put into it two ounces of the whiteſt amber you can get, finely powdered. This is to be put in by a little and little, gradually, keeping it ſtirring all the while with a ſmall ſtick, over a gentle fire, till it diſſolves, pouring in now and then a little oil of turpentine, as you find it growing ſtiff; and continue ſo to do till all your amber is melted. But great care muſt be taken not to ſet the houſe on fire, for the very vapours of the oil of turpentine will take fire by heat only; but if it ſhould happen ſo to do, immediately

put a flat board or wet blanket over the fiery pot, and by keeping the air from it, you will put it out, or ſuffocate it. Therefore it will be beſt to melt the roſin, in a glaſs of cylindric figure, in a bed of hot ſand, after the glaſs has been well annealed, or warm'd by degrees in the ſand, under which you muſt keep a gentle fire. When the varniſh has been thus made, pour it into a coarſe linen bag, and preſs it between two hot boards of oak or flat plates of iron; after which it may be uſed with any colours in painting, and alſo for varniſhing them over when painted. But for covering gold, you muſt uſe the following varniſh; mean time, it is to be obſerved, that when you have varniſhed with white varniſh, you may put the things varniſhed into a declining oven, which will harden the varniſh.

*A hard Varniſh, that will bear the Muffle.*] Take of colophony, an ounce; ſet it over the fire in a well glazed earthen veſſel, till it is melted; then by little and little, ſtrew in two ounces of powder of amber, keeping it ſtirring all the while with a ſtick; and when you perceive it begin to harden or reſiſt the ſtick, then put in a little turpentine oil, which will thin and ſoften it immediately: then put in two ounces of gum copal, finely powdered, ſprinkling it in as you did the amber, now and then pouring in a little oil of turpentine; and when it is done, ſtrain it as before directed. This is proper to varniſh over gold; and the things done with it muſt be ſet into a declining oven, three or four days ſucceſſively, and then it will reſiſt even the fire itſelf.

*To make a Varniſh for Gold, or Metals made in imitation of Gold.*] Take colophony, and, having melted it, put in two ounces of amber finely powdered, and ſome ſpirit of turpentine, and, as the amber thickens, keep it well ſtirring; then put in an ounce of gum elemi, well pulveriſed, and more ſpirit of turpentine; conſtantly ſtirring the liquor till all is well mixed and incorporated: but take care, however, to uſe as little turpentine as you can, becauſe, the thicker the varniſh is made, the harder it will be. Let this be done over a ſand heat, in an open glaſs; then ſtrain

it, as is directed for the preceding varnish. This varnish is to be used alone, first warming the vessels made of paper paste; and lay it on with a painting brush before the fire, but not near, lest the fire raise it into blisters. After this has been done, harden it three several times in an oven; first with a slack heat, the next with a warmer, and the third with a very hot one; and the vessels will look like polished gold. And as for such vessels, &c. as shall be made with saw dust and gums, the varnish may be made of the same ingredients as above-meationed, except the gum elemi; and this will dry in the sun, or in a gentle warmth.

*Laying on of Varnishes.*] 1. If you varnish wood, let your wood be very smooth, close grained, free from grease, and rubbed with rushes. 2. Lay on your colours as smooth as possible; and, if the varnish has any blisters in it, take them off by a polish of rushes. 3. While you are varnishing, keep your work warm but not too hot. 4. In laying on your varnish, begin in the middle, and stroke the brush to the outside; then to another extreme part, and so on till all be covered; for if you begin at the edges, the brush will leave the blots there, and make the work unequal. 5. In fine works use the finest tripoli in polishing: do not polish it at one time only; but, after the first time, let it dry for two or three days, and polish it again for the last time. 6. In the first polishing you must use a good deal of tripoli, but in the next a very little will serve; when you have done, wash off your tripoli with a sponge and water; dry the varnish with a dry linen rag; and clear the work, if a white ground, with oil and whiting; or if black, with oil and lamp black.

*Painting in Oil.*] The whole secret of painting in oil consists in grinding the colours with nut-oil, or linseed-oil; but the manner of working is very different from that in fresco, or in water, by reason the oil does not dry near so fast, which gives the painter an opportunity of touching and re-touching all the parts of his figures as often as he pleases; which in the other methods of painting is a thing impracticable. The figures done

in oil, are alſo capable of more force and boldneſs; inſo-much, that the black becomes blacker, when ground with oil, than with water; beſides, all the colours mixing better together, makes the colouring the ſweeter, more delicate and agreeable, and gives an union and tenderneſs to the whole, inimitable in any of the other manners. Painting in oil is performed on canvas, on walls, wood, ſtone, and all other ſorts of medals.

*Painting on Cloth or Canvas is done as follows.*] The canvas being ſtretched on a frame, give it a layer of ſize, or paſte-water, and then go over it with a pumice-ſtone, to ſmooth off the knots. By means of the ſize, the little threads and hairs are all laid cloſe on the cloth, and the little holes filled up, ſo that no colour can paſs through. When the cloth is dry, lay on okre in oil, which may be mixed with white-lead to make it dry the ſooner. When dry, go over it again with the pumice-ſtone, to make it ſmooth. After this a ſecond couch is ſometimes applied, compoſed of white lead and a little charcoal-black, to render the ground of an aſh colour. Others prime the canvas in the following manner; they firſt ſmooth the canvas with a pumice-ſtone, ſize it over with good ſize, and a little honey, and let it ſtand to dry; after which they lay it over with whiting and ſize, mixed with a little honey: the uſe of the honey is to prevent it from cracking, peeling, and breaking out; on this they firſt draw the picture with a coal, and then lay on the colours.

*Painting on Walls.*] When the wall is dry, they give it two or three waſhes with boiling oil, till the plaiſter remains quite greaſy, and will imbibe no more; upon this they lay drying colours, ſuch as white chalk, red okre, or other chalks beaten pretty ſtiff. When this couch or layer is well dried, the ſubject, or deſign, is ſketched out, and afterwards painted over, mixing a little varniſh with their colours, to ſave the varniſhing afterwards. In order the better to fortify the walls againſt moiſture, ſome cover it with a plaiſter of lime, marble duſt, or cement made of beaten tiles ſoaked in linſeed-oil; and at laſt prepare a compoſition of Greek

pitch, maſtic, and thick varniſh boiled together, which they apply hot over the former plaiſter; and when dry, lay on the colours as before. Others, in fine, make their plaiſter with lime-mortar, tile cement, and ſand; and this being dry, they apply another of lime, cement and iron-ſcoriæ; which being well beaten, and incorporated with linſeed-oil, and whites of eggs, make an excellent plaiſter. When this is dry, the colours are laid on as before.

*In Painting on Wood.*] They uſually give their ground a couch or layer of white tempered with ſize, and then proceed as in painting on walls.

*In Painting on Stone or Metals.*] It is not neceſſary to lay them over with ſize, but only to add a ſlight couch of colours before the deſign is drawn on it: nor even is this done on ſtones, where you would have the ground appear, as in certain marbles and agates of extraodinary colours.

*All the Colours uſed in Freſco.*] Are good in oil, except white of lime and marble duſt. Thoſe chiefly uſed are white-lead, or ceruſe, yellow and white maſticot, orpiment, vermillion, lacca, blue and green aſhes, verdigriſe, indigo, ſmalt, black lead, ivory-black, lamp-black, &c. As to oils, the beſt of thoſe are linſeed, walnuts, ſpike, and turpentine. The drying oils are nut oil, boiled with litharge and ſandarach, or otherwiſe with ſpirit of wine, maſtic and gum lacca. In the preparation of oil-colours, care muſt be taken that they be ground fine: that in putting them on a pallet, thoſe which will not dry of themſelves be mixed with drying oil, or other ingredients of a drying quality: and that the tinged colours be mixed in as ſmall quantities as poſſible. As to the ſituation of the colours, the pureſt and ſtrongeſt muſt be placed in the front of the piece, and the colouring varied according to the ſubject, time and place. If the ſubject be grave, melancholy or terrible, the general teint of the colouring muſt incline to brown and black, or red and gloomy: but it muſt be gay and pleaſant in ſubjects of joy and triumph.

*Colour, in Dying, &c.*] There are, in the art of

dying, five colours, called simple, primary, or mother colours, from the mixture of which all other colours are formed: these are blue, yellow, brown, red and black. Of these colours, variously mixed and combined, they form the following colours, pansy, blue and scarlet are formed: amaranth, violet, and pansy: from the same mixture of blues, crimson and red, are formed the columbine or dove colour, purple crimson, amaranth, pansy, and crimson violet. Here it is to be observed that they give the name crimson to all colours made with cochineal.

*Of blue and red* madder is died purple, pepper colour, tan colour, and dry rose colour.

The same blue with red half in grain, makes amaranth, tan colour, and dry rose colour.

*Blue and half red crimson*, compose amaranth, tan colour, dry rose, a brown pansy, and sun brown.

*Blue and yellow, mixed together*, compose a yellow green, spring green, grass green, laurel green, brown green, dark green, as well as sea green, parrot green, cabbage green, &c. These three last colours are to be less boiled than the rest. It is to be noted, that as to green, there is no ingredient or drug in nature that will dye it: but the stuffs are dyed twice, first in blue, then in yellow.

*Blue and brown.*] These two colours are never mixed alone, but with the addition of red, either of madder or cochineal, they form several colours.

*Red and yellow.*] All the shades composed of these two colours, as gold, yellow, aurora, marygold, orange, nacarat, granat-flower, flame colour, &c. are made with yellow and red of madder, scarlet being less proper as well as too dear.

*Red and brown.*] Of these two colours are formed cinnamon colour, chesnut, musk, bear's hair, and even purple, if the red be of madder.

*Yellow and brown.*] The colours formed from these two, are all the shades of feuillemort, and hair colours. But this may be taken notice of, that though it be said that there are no colours or shades made from such and

such mixtures, it is not meant that none can be made, but that they are more eafily formed from a mixture of other colours.

*Dying in general.*] The art of dying conſiſts in giving a laſting colour to ſilks, cloths, and other ſubſtances, whereby the beauty is much improved, and value enhanced: and this art chiefly depends on three things, viz. 1. Diſpoſing the ſurface of the ſtuffs to receive and retain the colours, which is performed by waſhing them in different lyes, digeſting, beating them, &c. in which human urine putrified, a ſharp ſalt of aſhes, divers ſoaps, and galls of animals, are of principal uſe; by means whereof the viſcous gluten of the ſilk-worms naturally adhering to their threads, is waſhed and cleanſed from them, and thus they become fitted gradually to imbibe the colours. By theſe alſo the greaſy foulneſs adhering to wool and flax is ſcoured off. 2. So to grind the colours, as that they may enter the body duly prepared, and preſerve their brightneſs undiminiſhed. 3. The third conſiſts in having beautiful colours.

*The Materials uſed in the Art of Dying.*] Are iron and ſteel, or what is produced from them, in all true blacks, called Spaniſh blacks, though not in Flanders blacks, viz. they uſe copperas, ſteel filings, and ſlippe; they alſo uſe pewter for bowe-dye ſcarlet, viz. they diſſolve bars of pewter in aquafortis; litharge is alſo uſed by ſome, though acknowledged by few to add weight to dyed ſilk. Antimony is much uſed to the ſame purpoſe. Arſenick is uſed in crimſon upon pretence of giving luſtre, although thoſe who pretend not to be wanting in giving luſtre, to their ſilks, diſown its uſe. Verdigriſe is alſo uſed by linen dyers in their yellow and greeniſh colours; though, of itſelf, it ſtrikes no deeper colour than that of a pale ſtraw. Of mineral ſalts uſed in dying, the chief is alum; the true uſe whereof ſeems to be in regard to the fixation of colours. The next mineral ſalt is ſalt-petre, not uſed by antient dyers and but by few of the modern: nor is it yet uſed but to brighten colours, by back boiling of them, for

which argol is more commonly used: lime is much used in working blue vats.

Of the animal family are used cochineal, urine of labouring men kept till it be stale and stinking, honey, yolks of eggs, and ox-gall; the use of the urine is to scour, and help the fermenting and heating of wool; and is used also in blue vats instead of lime: it dischargeth the yellow, and therefore is used to spend well withall.

Dyers use two sorts of water, viz. river and well water; the last, which is harsh, they use in reds and other colours wanting restringency, and in dying materials of the slacker contextures, as in callico, fustian, and the several species of cotton works; but it is not good for blues, and makes yellows and greens look rusty.

River water is more fat and oily, and is therefore used in most cases, and must be had in great quantities for washing and rinsing their cloths after dying. Water is called by dyers white liquor; but a mixture of one part bran, and five of the river water boiled an hour and put into leaden cisterns to settle, is what they call liquors absolutely.

Gums have been used by dyers about silk, viz. gum arabic, tragacanth, mastic, dragon's blood. These tend little to the tincture, any more than gum in writing ink, which only gives it a consistence: so gum may give the silk a glossiness; and lastly, to increase the weight.

The three peculiar ingredients for black are copperas, filings of steel, and slippe; the restringent binding materials are alder-bark, pomegranate peels, walnut rinds and roots, oaken sapling bark, and saw-dust of the same, crab tree bark, galls, and sumac.

The salts are alum, salt-petre, sal ammoniac, pot ashes, and stone lime; among which urine may be enumerated as a liquid salt.

The liquors are well and river water, urine, aquavitæ, vinegar, lemon juice, aquafortis, honey, and molosses.

Ingredients of another class are bran, wheaten flour,

yolks of eggs, leaven, cummin ſeed, fenugreek ſeed, agaric and ſenna.

The ſmectics, or abſterſives, are fuller's earth, ſoap, linſeed oil, and ox-gall.

The metals and minerals are pewter, verdigriſe, antimony, litharge, and arſenic.

The colourings are of three ſorts, viz. blue, yellow, and red; of which logwood, old fuſtic, indigo and madder, are the chief.

*General Obſervations upon Dying.*] 1. All materials which of themſelves do give colour are either red, yellow, or blue; ſo that out of them, and the primitive fundamental colour white, all that great variety which we ſee in dyed ſtuffs doth ariſe.

2. That few of the colouring materials, as cochineal, foot, wood, wax, woad, &c. are in their outward and firſt appearance of the ſame colour, which by the ſlighteſt diſtempers and ſolutions in the weakeſt menſtrua, they dye upon cloth, ſilk, &c.

3. That many of them will not yield their colours without much grinding, ſteeping, boiling and fermenting, or corroſion by powerful menſtrua, as red wood, weld, woad, arnotta, &c.

4. That many of them will of themſelves give no colouring at all, as copperas or galls, or with much diſadvantage, unleſs the cloth or other ſtuff to be dyed be as it were firſt covered, or incruſtated with ſome other matter, though colourleſs aforehand, as madder, weld, braſil, with alum.

5. That ſome of them, by the help of other colourleſs ingredients, do ſtrike different colours from what they would of themſelves, as cochineal, brazil, &c.

6. That ſome colours, as madder, indigo and woad, by reiterated tinctures, will at laſt become black.

7. That although green be the moſt frequent and moſt common of natural colours, yet there is no ſimple ingredient now uſed alone to dye green with upon any material, ſap-green being the neareſt, which is uſed by country people.

8. There is no black thing in uſe which dyes black,

though both the coal and foot of moſt things burnt or ſcorched be of that colour, and the blacker, by how much the matter before being burnt was whiter, as in ivory-black.

9. The tincture of ſome dying ſtuffs will fade even with lying, or with the air, or will ſtain with water only, but very much with urine, vinegar, &c.

10. Some of the dying materials are uſed to bind and ſtrengthen a colour; ſome to brighten it; ſome to give luſtre to the ſtuff; ſome to diſcharge and take off the colour, either in whole or in part; and ſome out of fraud, to make the material dyed, if coſtly, heavier.

11. That ſome dying ingredients, or drugs, by the coarſeneſs of their bodies, make the thread of the dyed ſtuff ſeem coarſer; and ſome by ſhrinking them, ſmaller; and ſome, by ſmoothing them, finer.

12. Many of the ſame colours are dyed upon ſeveral ſtuffs with ſeveral materials, as red-wood is uſed in cloth, not in ſilks; arnotta in ſilks, not in cloth, and may be dyed at ſeveral prices.

13. That ſcouring and waſhing of ſtuffs to be dyed, is done with ſpecial materials, as ſometimes with ox-galls, ſometimes with fuller's-earth, and ſometimes ſoap; this latter being, in ſome caſes, pernicious, where pot-aſhes will ſtain or alter the colour.

14. Where great quantities of ſtuffs are to be dyed together, or where they are to be done with any ſpeed, and where the pieces are very long, broad, thick, or otherwiſe, they are to be differently handled, both in reſpect to the veſſels and ingredients.

15. In ſome ſtuffs and colours the tingent liquor muſt be boiling, in other caſes blood warm, and in ſome it may be cold.

16. Some tingent liquors are fitted for uſe by long keeping, and in ſome the virtues wear away by the keeping.

17. Some colours or ſtuffs are beſt dyed by reiterated dippings in the ſame liquor, ſome by continuing longer, and others a leſſer time therein.

18. In ſome caſes, the matter of the veſſel wherein

the liquors are heated, and the tincture prepared, muſt be regarded, as the kettles muſt be pewter for bow-dye.

19. There is little reckoning made how much liquor is uſed in proportion to the dying drugs, it being rather adjuſted to the bulk of the ſtuffs, as the veſſels are to their breadth; the quantity of dying drugs being proportioned both to the colour, higher or lower, and to the ſtuffs: as likewiſe the ſalts are to the dying drugs. Concerning the weight that colours give to ſilk (in which it is moſt taken notice of being ſold by weight, and a commodity of great price), it is obſerved that one pound of raw ſilk loſeth four ounces by waſhing out the gums, and the natural ſordes. That the ſame ſcoured ſilk may be raiſed to above thirty ounces from the remaining twelve, if it be dyed black with ſome materials.

Of a thing very uſeful in dying, eſpecially of black, nothing increaſes weight ſo much as galls, by which black ſilks are reſtored to as much weight as they loſt by waſhing out their gum: nor is it counted extraordinary that blacks ſhould gain about four or ſix ounces in the dying, upon each pound.

Next to galls, old fuſtic increaſes the weight $1\frac{1}{2}$ in 12; madder, about one ounce; weld, half an ounce. The blue vats in deep blues of the 5th ſtall, give no conſiderable weight; neither doth logwood, cochineal, nor even copperas, where galls are not: ſlippe adds much to the weight, and giveth a deeper black than copperas itſelf, which is a good excuſe for the dyers that uſe it.

*Dying of wool and woollen manufactures.*] For black in woollen manufactures, it is begun with a ſtrong decoction of woad and indigo, that communicate a deep blue; after which the ſtuffs being boiled with alum and tartar, or pot-aſh, are to be maddered with common madder, then dyed black with Aleppo galls, copperas, and ſumac, and finiſhed by back boiling in weld. Wools for tapeſtry are only to be woaded, and then put in black. For ſcarlet, wool and woollen manufactures are dyed with kermes and cochineal, with which may

alſo be uſed agaric and arſenic. Crimſon ſcarlet is dyed with cochineal, maſtic, aquafortis, ſal ammoniac, ſublimate, and ſpirit of wine. Violet ſcarlet, purple, amaranth, and panſy ſcarlets, are given with woad, cochineal, indigo, braziletto, brazil and orchal. Common reds are given with pure madder, without any other ingredient. Crimſon reds, carnations, flame and peach colours, are given, according to their ſeveral hues, with cochineal, maſtic, without madder, or the like. Crimſon red is prepared with Roman alum with cochineal. Orange aurora, brick colour, and onion peel colour, are dyed with woad and madder, mixed according to their ſeveral ſhades. For blues, the dark are dyed with a ſtrong tincture of woad; the brighter with the ſame liquor, as it weakens in working. Dark browns, minims, and tan colours, are given with woad, weaker in decoction than for black, with alum and pot-aſhes, after which they are maddered higher than black: for tan colours, a little cochineal is added. Pearl colours are given with galls and copperas; ſome are begun with walnut tree roots, and finiſhed with the former; though to make them more uſeful, they generally dip them in a weak tincture of cochineal. Greens are begun with woad, and finiſhed with weld. Pale yellows, lemon colour, and ſulphur colour, are given with weld alone. Olive colours of all degrees are firſt put in green, and taken down with ſoot, more or leſs, according to the ſhade that is required. Feulemort, hair colour, muſk, and cinnamon colour, are dyed with weld and madder. Nacarat, or bright orange, is given with weld and goats hair boiled with pot-aſhes.

*Dying of Silks.*] This is begun by boiling them in ſoap, &c. then ſcouring and waſhing them in water, and ſteeping them in cold alum water. For crimſon, they are ſcoured a ſecond time before they are put into the cochineal vat. Red crimſon is given with pure cochineal, maſtic, adding galls, turmeric, arſenic, and tartar, all mixed in a copper of fair water almoſt boiling: with theſe the ſilk is to be boiled an hour and a half, after which it is allowed to ſtand in the liquor till

next day. Violet crimſon is given with pure cochineal, arſenic, tartar and galls; but the galls in leſs proportion than in the former: when taken out, it is waſhed and put in a vat of indigo. Cinnamon crimſon is begun like the violet, but finiſhed by back boiling, if too bright with copperas, and if dark, with a dip of indigo. Light blues are given in a back of indigo. Sky blues are begun with orchal, and finiſhed with indigo. For citron colours, the ſilk is firſt alumed, then welded with indigo. Pale yellows, after aluming, are dyed in weld alone. Pale and brown auroras, after aluming, are welded ſtrongly, then taken down with rocou and diſſolved with pot-aſhes. Flame colour is begun with rocou, then alumed, and afterwards dipped in a vat or two of brazil. Carnation and roſe colours are firſt alumed, then dipt in brazil. Cinnamon colour, after aluming is dipt in brazil, and braziletto. Lead colour is given with fuſtic, or with weld, braziletto, galls and copperas. Black ſilks of the coarſer ſort, are begun by ſcouring them with ſoap, as for other colours; after which they are waſhed out, wrung, and boiled an hour in old galls, where they are ſuffered to ſtand a day or two: then they are waſhed again with fair water, wrung, and put into another vat of new galls; afterwards waſhed again, and wrung, and finiſhed in a vat of black. Fine black ſilks are only put once into galls of the new and fine ſort, that has only boiled an hour: then the ſilks are waſhed, wrung out, and dipped thrice in black, and afterwards taken down by back boiling with ſoap.

*The dying of thread.*] This is begun by ſcouring it in a lye of good aſhes: afterwards it is wrung, rinſed out in river water, and wrung again. A bright blue is given with braziletto and indigo: bright green is firſt dyed blue, then back-boiled with braziletto and verditer, and laſtly woaded. A dark green is given like the former, only darkening more before woading. Lemon and pale yellow is given with weld mixed with rocou. Orange iſabella, with fuſtic, weld and rocou. Red, both bright and dark, with flame colour, &c. are given

with brazil, either alone, or with a mixture of rocou. Violet, dry roſe, and amaranth, are given with brazil, taken down with indigo. Feulemort and olive-colour are given with galls and copperas, taken down with weld, rocou, or fuſtic. Black is given with galls and copperas, taken down and finiſhed with braziletto wood.

*A preparation for curing Wens, by which a perſon has acquired a conſiderable fortune, and much reputation.*] Take a quantity of ſnow, that has been collected in the coldeſt ſeaſon, ſufficient to produce a quart of water, when melted: add to this one ounce of Roman vitriol, and one drachm of camphire; theſe are to be put in the ſnow water; after this is made warm over a moderate fire, let it ſtand till fine; and then add thereto four ounces of ſpirit of wine, in which one drachm of the golden or July butter-flies have been infuſed. Theſe inſects are to be dried and powdered, before they are put into the ſpirits of wine; and care muſt be taken to produce the right ſort, as it appears that very much depends on them. They are to be had, in moſt places where flowers abound, about Midſummer; and are then in their prime. With this liquid the wens are to be rubbed night and morning for a month ſucceſſively, and ſucceſs will attend it, with very little pain or trouble to the patient. Snow, when uſed alone, is ſaid to have many valuable properties; as may be ſeen at large in Bartholin's Treatiſe de nivis uſu medico. It has been obſerved, in the cure of wens, that if the patient anoint the part with oil of ſweet almonds three or four days before uſing the above remedy, it will greatly forward the cure.

*Method of colouring Brandy.*] All brandies, when firſt made, are as clear as water, and do grow higher coloured by long keeping; however, they are artfully made of any colour ſeveral ways. To make a light ſtraw colour, uſe turmeric or a little treacle: but the beſt way is to give it a colour or tincture with a little burned ſugar made to a conſiſtence; or ſyrup of elderberries may be uſed, which gives an admirable colour, and may be made deeper or lighter, according to the quantity you put in.

*The way to make Sealing-wafers.*] Take very fine flour, mix it with glair of eggs, ifinglafs, and a little yeaft; mingle the materials; beat them well together, fpread the batter, being made thin with gum water, on even tin plates, and dry them in a ftove; then cut them out for ufe. You may make them of what colours you pleafe, by tinging the paſte with brazil or vermillion for red; indigo or verditer, &c. for blue.

*Sympathetic powder.*] The compoſition of the famous fympathetic powder, uſed at Goſſilaer by the miners in all their wounds, is this. Take of green vitriol, eight ounces; of gum tragacanth, reduced to an impalpible powder, one ounce; mix theſe together, and let a ſmall quantity of the powder be ſprinkled on the wound, and it immediately ſtops bleeding. The vitriol is to be calcined to whiteneſs in the ſun, before it is mixed with the gum.

*The virtues of a cruſt of bread, eat in a morning faſting; publiſhed by an eminent phyſician.*] In the above treatiſe, (which ſells for 1s. 9d.) the author only aſſerts, that a great many obſtinate diſorders, are cured by this ſimple remedy; and gives many inſtances of its great efficacy in the following caſes, viz. king's evil, cachexies, ſcurvies, leproſies, rheumatic complaints, &c. The author orders about half an ounce of hard cruſt, or ſea biſcuit, to be eat every morning faſting, for five or ſix weeks; and nothing to be taken after it in leſs than three or four hours.

*To purify butter, and make it of a moſt ſweet taſte.*] Melt butter with a ſlow fire in a well glazed earthen veſſel, which put to fair water, working them well together, and when it is cold take away the curds and the whey at the bottom. Do it again the ſecond time, and if you pleaſe, the third time in roſe-water, always working them very well together. The butter thus clarified will be as ſweet in taſte, as the marrow of any beaſt, and keep a long time, by reaſon of the great impurity which is removed by this means, the droſs being near a quarter of the whole.

*Conſtruction of Almanacks.*] The firſt thing to be done, is to compute the ſun's and moon's place for each day of the year, or it may be taken from ſome ephemerides, and entered in the almanack; next, find the dominical letter; and, by means thereof, diſtribute the calendar into weeks: then having computed the time of Eaſter, by it fix the other immoveable feaſts; adding the immoveable ones, with the names of the martyrs, the riſing and ſetting of each luminary, the length of day and night, the aſpects of the planets, the phaſes of the moon, and the ſun's entrance into the cardinal points of the ecliptic; that is, the two æquinoxes and ſolſtices. And theſe are the principal contents of almanacks; beſides which there are others of a political nature, and conſequently different in different countries, as the birth-days and coronations of princes, tables of intereſt, &c. As to the antiquity of almanacks, Ducange informs us, that the Egyptian aſtrologers, long before the Arabians, uſed the term almanack, and almenachica deſcriptio, for their monthly productions. Be that as it will, Regiomontanus is allowed to have been the firſt who reduced almanacks to their preſent form. On the whole, there appears to be no myſtery, or even difficulty, in almanack making, provided tables of the heavenly motions be not wanting

*A neceſſary* POCKET ALMANACK, *by which the day of the month is known, at firſt view, from the preſent time, to the year of our Lord* 1831.] Under the word years, find the year; above which is the dominical letter for that year——Then, againſt the month, in the other table, find the ſame letter, over which are placed the days of the month for every Sunday of that month.—Every blank ſpace ſhows the year following to be leap year——N. B. In every leap-year for January and February, uſe the letter above the blank ſpace before for that year.

| YEARS. | | | | | | |
|---|---|---|---|---|---|---|
| A | G | F | E | D | C | B |
| 1758 | 59 | | 60 | 61 | 62 | 63 |
| | 64 | 65 | 66 | 67 | | 68 |
| 69 | 70 | 71 | | 72 | 73 | 74 |
| 75 | | 76 | 77 | 78 | 79 | |
| 80 | 81 | 82 | 83 | | 84 | 85 |
| 86 | 87 | | 88 | 89 | 90 | 91 |
| | 92 | 93 | 94 | 95 | | 96 |
| 97 | 98 | 99 | 1800 | 1 | 2 | 3 |
| | 4 | 5 | 6 | 7 | | 8 |
| 9 | 10 | 11 | | 12 | 13 | 14 |
| 15 | | 16 | 17 | 18 | 19 | |
| 20 | 21 | 22 | 23 | | 24 | 25 |
| 26 | 27 | | 28 | 29 | 30 | 31 |

| SUNDAYS. | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Jan. Oct. | A | B | C | D | E | F | G |
| May. | B | C | D | E | F | G | A |
| Aug. | C | D | E | F | G | A | B |
| Feb. Mar. Nov. | D | E | F | G | A | B | C |
| June. | E | F | G | A | B | C | D |
| Sep. Dec. | F | G | A | B | C | D | E |
| Apr. Jul. | G | A | B | C | D | E | F |

*To make an artificial Malaga wine.*] Take a wine veſſel well hooped with iron hoops, and one end open, to which a cloſe cover muſt be fitted to put on and take off at pleaſure, ſet it in a warm place, fill it full of fair water, to every gallon of which put two pounds of Malaga raiſins, firſt bruiſed in a ſtone mortar; and to every twenty gallons of water a good handful of calx vive: cover the veſſel cloſe, and keep it warm with cloths: let it ſtand four or five days to work: then ſee if the raiſins be riſen up, and beat them down, and co-

ver it again as before, beating them down every fourth or fifth day for three or four weeks: then put a tap in, four inches above the bottom, and see if it tastes like wine; if not, let it stand a while longer; after which draw it off into another wine vessel, and to every twenty gallons put a pint or quart of the best spirit of wine (as you would have it in strength) two new laid eggs, and a quart or better of Alicant well beaten together. Let it stand in a cellar as other wine till it is fine, and fit to be drank.

*To make an artificial claret.*] Take water, six gallons: choice cyder, two gallons: best Malaga raisins bruised, eight pounds: mix and let them stand all in a warm place fourteen days, stirring them well once every day. Then press out the raisins, and put the liquor into the vessel again, to which add juice of rasberries a quart: juice of black cherries a pint: juice of black berries a pint and a half: cover this liquor with bread, spread thick with strong mustard; the mustard side being downwards, and so let it work by the fire three or four days; after which turn it up, let it stand a week, and bottle it up, so will it become a very brisk and pleasant drink, and far better and wholesomer than our common claret.

*To make an artificial malmsey.*] Take eight gallons of spring water: honey two gallons: make them boil over a gentle fire for an hour: take it off, and when it is cold, put it into a runlet, hanging in the vessel a bag of spices, and set it in the cellar for half a year, at the end of which you may drink it.

*To make rasberry wine.*] Take Canary a gallon: rasberries two gallons: mix and digest twenty-four hours: strain them out, and add raisins of the sun stoned three pounds: digest again four or five days, sometimes stirring them together: then pour off the clearest, and put it up into bottles, which put into a cold place: if it be not sweet enough you may dulcify it with sugar.

*Another way to do the same.*] Take juice of rasberries, bottle it up close, and set it in a cellar, and it will

become clear, and keep all the year long, and be very fragrant; a few spoonfuls of this put into a pint of wine sweetened with sugar, will give it a full taste of the berry: two or three ounces of the syrup of the juice will do the same.

*To purify oil olive, that it may be eaten with pleasure.*] Take fair water two quarts, oil olive a pint: mix and shake them well together for a quarter of an hour in a glass; then separate the water from the oil with a separating funnel. Do this four or five times or more, as you see occasion, till the oil becomes very pure; and the last time wash it with rose-water, then hang in the midst of the oil a coarse bag full of bruised nutmegs, cloves, and cinnamon, so will you give it an excellent taste.

*To make sage, parsley, or pennyroyal butter.*] When the butter is newly made, and well wrought from its water, milk, and wheyish part, mix therewith a little oil of sage or parsley, so much till the butter is strong enough in taste to your liking, and then temper them well together; this will excuse you from eating the plants therewith; and if you do this with the aforesaid clarified butter, it will be far better, and a most admirable rarity.

*To purify and refine sugar.*] In a strong lixivium of calx vive dissolve as much coarse sugar as it will bear, adding to every quart of liquor, two whites of eggs, beaten into glair, stir them well together, and make them boil a little, taking off the scum, as long as any will arise; then pass all through a great woollen cloth bag, then boil the liquor again so long till being dropt upon a cold plate, being cold, it is as hard as salt; this done, put it out into pots or moulds for that purpose, having a hole in the narrower end thereof, which must be stopped for one night, afterwards being opened, the molosses or treacle will drop forth; then cover the ends of the pots with potters' clay, and as that clay sinks down, by reason of the sinking of the sugar, fill them up with more clay, doing thus, till the sugar will sink no more. Lastly take it out, and being hard and dry, bind it up in papers.

*To make a plant grow in two or three hours.*] Take aſhes of moſs, which moiſten with the juice of an old dunghill (being preſſed out and ſtrained) then dry them a little, and moiſten them as before; do this four or five times; put this mixture, not being very dry nor very moiſt, into an earthen veſſel, and in it ſet ſeeds of lettuce, purſlane, or parſley, (for they will grow ſooner than other ſeeds) being firſt impregnated with the eſſence of a vegetable of its own ſpecies (ſome ſay the juice of the ſame plant, but eſpecially the ſpirit will do inſtead of the eſſence;) till they begin to ſprout forth; which then put into the ſaid earth, with that end upwards which ſprings. Put the veſſel into a gentle heat, and when it begins to dry, moiſten it with the ſaid juice of dung: thus may you have a ſallad while ſupper is making ready.

*To reduce a whole vegetable into a liquor which may be called the eſſence thereof.*] Take the whole plant with flowers and roots, bruiſe them in a mortar, put all into a large glaſs veſſel, (but a wooden one is better) ſo that two of three parts may be empty; cover it exceeding cloſe, and let it ſtand in putrefaction in a moderate heat for a year, and it will all be turned into a water.

*To make the lively form and idea of any plant appear in a glaſs.*] Take the former water, of vegetable, diſtil it in a good glaſs in aſhes, and there will come forth a water and oil, and in the upper part of the veſſel a volatile ſalt; the oil ſeparate and keep by itſelf; with the water diſſolve the volatile ſalt, and purify it by filtering and coagulating. This purified ſalt imbibe with the ſaid oil until it will imbibe no more; digeſt them well together for a month in a veſſel hermetically ſealed; ſo will you have a moſt ſubtle eſſence, which being held over a gentle heat, or the flame of a candle, by which means it may be made hot, you will ſee the fine ſubſtance (which is like impalpable aſhes or ſalt) ſend forth from the bottom of the glaſs, the manifeſt form and idea of the vegetable, vegetating and growing by little and little, and putting on ſo fully the form of ſtalks, leaves, and flowers, in ſuch perfect and natural wiſe,

that one would believe the same to be real; when as in truth it is the spiritual idea, arising with the spiritual essence of the plant; this, were it joined with its proper earth, would take to itself a more solid body. Now as soon as the vessel or glass is removed from the fire, this idea or representation vanishes, becoming a chaos and confused matter, returning to its sediment, from whence it arose.

*Another way to make the essence of a plant.*] Put the herbs, flowers, seeds, spices, &c. into rectified spirit of wine: extract a very strong and deep tincture, upon which put strong oil of salt, and digest in Balneo, till an oil swim above, which separate. Or else draw off the spirit of wine in Balneo, and the oil or essence will remain at bottom: but before the spirit of wine is abstracted, the oil or essence is blood red, and a true quintessence.

*Another way to make the true essence, or rather quintessence.*] Make the water, oil, and volatile salt, as before is taught; and from the fæces extract the fixed salt, which purify according to art; which salt resolve in a cellar upon a marble stone to an oil, which is what we call per deliquium, filter it and evaporate, till the salt is white as snow, with these salts imbibe as much of the oil as you can make it receive; then digest till the oil will not separate from the salt, but become a fixed powder, melting with an easy heat.

*To make the form of a firr tree appear in Colophonia.*] Distil turpentine in a retort gradatim: when all is distilled off, keep the retort still in a reasonable heat, that what humidity is still remaining may be evaporated, and it become dry. Take it then off from the fire, and hold your hand to the bottom of the retort, and the turpentine which is dried, (called also colophonia or rosin) will crack asunder in several places, and in those cracks, or chaps, you shall see the perfect figure of firr trees, which will there continue many months.

*To make hartshorn seemingly grow in a glass.*] Take hartshorn broken into small bits, and put them into a glass retort to be distilled, and you shall see the glass

to be seemingly full of horns; which will continue there so long, till the volatile salt be come over.

*To make a durable and lasting oil.*] 1. Take unslacked lime, bay salt, oil olive, of each a like quantity; mix them well together, and distil in sand: cohobate the oil upon the same quantity of fresh lime and salt; this do four times. 2. The oil by this means will be clear, and impregnated with what salt was volatile in the lime and salt. 3. If it be seven times distilled, it will be as pure, odoriferous, and subtle, as many distilled oils of vegetables. 4. This oil whilst distilling, has a most fragrant smell, and of a most durable quality, which durability comes from the saline impregnation; besides which, it is good against any inveterate ache or pain in the limbs, or other parts. 5. A lamp made with this oil, will burn six or seven times as long, as that which is made with other oil; also it burns very sweet. 6. You ought to be very cautious in making of it, or else your glasses will quickly break. 7. You must take very strong lime, such as your dyers use, and call Cauk.

*To make a candle that shall last long.*] Mix with your tallow unslacked lime in powder; or make your candles of castile-soap: such candles as these will be admirable for lamp furnaces. Now it is the salt in the lime and soap, that preserves the tallow from burning out so fast, as otherwise it would.

*To make the distilled oil out of any herb, seed, flower, or paper, in a moment, without a furnace.*] You must have a long pipe made of tin, or tobacco-pipe clay with a hole in it as big as a small walnut, three or four inches from one end of it, into which you must put the matter, you would have the oil off; set it on fire with a candle or a coal; then put one end of the pipe into a bason of fair water, and blow at the other end, so will the smoak come into the water, and the oil will swim upon it, which you may separate with a funnel.

*To reduce rosin into turpentine again.*] Take oil of turpentine and the colophonia, or rosin thereof, in powder; mix these together, and digest them, and you

ſhall have turpentine of the ſame conſiſtency it was before; but of a more fiery and ſubtile nature: pills made thereof are more excellent for opening obſtructions of the breaſt, lungs, kidnies, bowels, &c. than thoſe that are made of raw turpentine.

*To write or engrave upon an egg, pebble, flint, &c.*] Write what you pleaſe with wax or greaſe upon an egg, pebble, flint, &c. then put it into the ſtrongeſt ſpirit of vinegar, or oil of ſalt, letting it lie two or three days; and you ſhall ſee every place about the letters or writing, eaten or conſumed away; but the place where the wax or greaſe was not at all touched.

*To make a powder, which being wetted ſhall be kindled.*] 1. Take a load-ſtone, powder it, and put it into a ſtrong crucible; cover it all over with a powder made of calx vive and colophonia, of each a like quantity; put alſo ſome of this powder under it: when the crucible is full, cover it, and lute the cloſures with potters' earth, put it into a furnace, and there let it boil; after take it out, and put the matter into another crucible, and ſet it in a furnace alſo, this do till it becomes a very white and dry calx. 2. Take of this calx one part; ſal nitre well purified four parts; and as much camphire, ſulphur vive, oil of turpentine and tartar; grind what is to be ground to a ſubtile powder, and put all into a glaſs veſſel, with as much well rectified ſpirit of wine, as will cover them two inches over. 3. Stop the veſſel cloſe up, and ſet it in horſe dung three months, ſo will all the matter become an uniform paſte: evaporate all the humidity, until the whole maſs becomes a very dry ſtone; which take out, powder it, and keep it very dry. 4. If you take a little of this powder, and ſpit upon it, or pour ſome water thereon, it will take fire preſently, ſo that you may light a match, or any ſuch thing by it.

*To make a room ſeem to be on fire.*] Take rectified ſpirit of wine, and diſſolve camphire therein; evaporate this in a very cloſe chamber, where no air can get in; and he that firſt enters the chamber with a lighted candle, will be amazed; for the chamber will ſeem to be full of fire, and very ſubtile, but of little continu-

ance. This done in a close cupboard or press, will be much more perspicuous and visible.

*To make the four elements appear in a glass.*] Take jet in fine powder an ounce and half: oleum tartari per deliquium (made without addition of any water) two ounces, coloured with a light green with verdigrise: add thereto spirit of wine tinged with a light blue with indigo, two ounces: of the best rectified spirit of turpentine, tinged of a light red with madder, two ounces: mix all these in a glass, and shake them together, and you shall see the heavy black jet fall to the bottom, and represent the earth: next the oil of tartar made green falls, representing the water: upon that swims the blue spirit of wine, representing the air or sky; and uppermost of all will swim the subtile red oil of turpentine, representing the element of fire. It is strange to see how after shaking all these together, they will be distinctly separated one from another. If it be well done, (as it is easy to do it) it is an admirable and glorious sight.

*To represent the whole world in a glass.*] Take the finest sal-nitre, what you please; tin, half so much; mix them well together, and calcine them hermetically: then put them into a retort, to which adjoin a glass receiver, with leaves of gold put into the bottom thereof; lute them well together; put fire to the retort, until vapours arise that will cleave to the gold: augment the fire till no more fumes ascend; then take away the receiver; close it hermetically, and make a lamp fire under it: and you will see represented in it, the sun, moon, stars, fountains, trees, herbs, plants, flowers, fruits, and indeed, even all things, after a very wonderful manner.

*To make regulus of antimony, for antimonial cups.*] Take antimony in powder, nitre, of each a pound; crude tartar in fine powder, two pounds; mix, put them into a crucible, cover the crucible, and melt, so will the regulus fall to the bottom, which pour into a brass mortar smeared with oil. Or thus: Take antimony powdered, two pounds; crude tartar in powder,

four pounds; melt as before. This regulus you may cast into cups, pictures, medals, or what figures you please: these infused into two or three ounces of wine in an earthen glazed vessel, or in a glass, in a gentle heat all night, gives you a liquor in the morning which will vomit: dose, from two drachms to two ounces and a half; you may sweeten it if you please with a little white sugar. These cups or pictures will last for ever, and be as effectual after a thousand times infusion as at first.

*To make Barbers' wash balls.*] Take purified Venetian soap six ounces, macaleb four ounces, ireos, amylum, of each seven ounces, cloves two ounces, labdanum, anniseeds of each one ounce, nutmegs, marjoram, Cypress powder, geranium moschatum, camphire, of each half an ounce, storax liquida half a drachm, musk ten grains, all being in fine powder, with a little fine sugar, beat all in a mortar, and make them up into wash balls.

*To make common wash-balls, the best of that kind.*] Take Venice or Castile-soap sliced very thin, four pounds, spirit of wine half a pint, beat all together; then add chemical oil of sassafras or lemons an ounce or more; and beat again very well: lastly, add white starch made into a paste with water, by boiling a sufficient quantity to make all into an even and smooth mass, which form into balls of four ounces a piece, with powder of white starch, dry them and keep them for use.

*To make unguentum pomatum, or ointment of apples.*] Take hog's lard three pounds, sheep's suet nine ounces, bruised cloves one drachm, aqua rosarum two ounces, pomwaters pared and sliced one pound, boil all to the consumption of the rose-water; then strain without pressing, to every pound of which add oil of rhodium and cinnamon, of each thirty drops.

*To make a compound pomatum.*] Take of the pomatum aforesaid (without the oils) four pounds, spicknerk, cloves, of each two ounces, cinnamon, storax, benjamin, of each one ounce, (the spices and gums bruised and tied up in a thin rag) rose-water, eight ounces; boil to the consumption of the rose-water, then add

white wax eight ounces, which mix well by melting, ſtrain it again being hot; and when it is almoſt cold mix therewith oil of muſk, then put it out, and keep it for uſe.

*To cleanſe the Skin.*] Waſh with warm water, and ſweet ſcented waſh balls very well; then rub the ſkin with a cloth, and waſh well with water in which wheat-bran has been boiled—Or thus, take ſublimate one ounce, glair of ſix eggs, boil them in a glaſs veſſel, till they grow thick, then preſs out the water, with which waſh the ſkin.

*To make the ſkin ſoft and ſmooth.*] The ſkin being very clean, as before directed, waſh it very well with a lixivium of ſalt of tartar, and after that anoint it with pomatum; or which is better, oil of ſweet almonds, doing this every night going to bed.

*A water to cleanſe the face from ſcurf and morphew.*] Take diſtilled rain water ſix ounces, juice of lemons twelve ounces, mix them, and waſh with it morning and evening, anointing after it at night going to bed with the oil or pomatum aforeſaid.

*An unguent which brings the ſkin to an exquiſite beauty.*] Take of pomatum one ounce, ſalt of tartar one drachm, muſk twenty grains, mix them well, and (the face or ſkin being very clean) anoint morning and evening.

*To make the hair lank and flag that curls too much.*] Anoint the hair thoroughly twice or thrice a week with oil of lilies, roſes, or marſh mallows, combing it after it very well.

*To make the hair grow long and ſoft.*] Diſtil hog's greaſe or oil of olive in an alembic; with the oil that comes therefrom anoint the hair, and it will make it grow long and ſoft: uſe it for uſe.

*To preſerve the hair from ſplitting at the ends.*] Anoint the ends thereof with oil omphacine, or oil of myrtles; they are eminent in this caſe to preſerve the hair from ſplitting, ſo alſo an ointment made of honey, bee's-wax, and oil omphacine, or bear's greaſe.

*A ſweet powder to lay among cloaths.*] Take damaſk-roſe leaves dried one pound, muſk half a drachm, violet

leaves three ounces, mix them and put them in a bag

*Another for the same, or to wear about one.*] Take roſe leaves dried one pound, cloves in powder half an ounce, ſpicknard two drachms, ſtorax, cinnamon, of each three drachms, muſk half a drachm, mix them and put them into bags for uſe.

*An excellent perfuming powder for the hair.*] Take iris roots in fine powder one ounce and a half, benjamin, ſtorax, cloves, muſk, of each two drachms: being all in fine powder, mix them for a perfume for hair-powder. Take of this perfume one drachm, rice-flower impalpable one pound, mix them for a powder for the hair. Note, ſome uſe white ſtarch, flower of French beans and the like.

*A perfume to ſmoak and burn.*] Take labdanum two ounces, ſtorax one ounce, benjamin, cloves, mace, of each half an ounce, muſk, civet, of each ten grains, all in fine powder, make it up into cakes with mucilage of gum tragacanth in roſe-water, which dry; and keep among your cloaths, which when occaſion requires, you may burn in a chafing-diſh of coals.

*To make red writing ink.*] Take raſpings of Brazil one ounce, white lead, alum, of each two drachms, grind and mingle them, infuſe them in urine one pound, with gum arabick two ſcruples, or a drachm at moſt.

*Another way to make red ink.*] Take wine vinegar two pounds, raſpings of Brazil two ounces, alum half an ounce, infuſe all ten days; then gently boil, to which add gum arabick five drachms, diſſolve the gum, ſtrain and keep it for uſe. *Note*, two drachms of the gum in ſome caſes may be enough.

☞ I forbear here to give a receipt for preparing a moſt exquiſite *Black Writing Ink*, having ſold the property of it to WILLIAM SPOTSWOOD, Printer and Bookſeller, Philadelphia, who intends ſhortly to offer it to the public ready prepared, at the ſame rate of the ordinary ſort of black ink. It is free from the ill qualities of the common black writing ink. I had it from a late eminent and much celebrated chemiſt.

*To make green ink to write with.*] Make fine verdigrise into paste with strong vinegar, an infusion of green galls, in which a little gum arabick hath been dissolved, let it dry, and when you would write with it, temper it with infusion of green galls aforesaid.

*Another way to make green ink to write with.*] Dissolve verdigrise in vinegar, then strain it, and grind it with a little honey and mucilage of gum tragacanth, upon a porphyry stone.

*To make blue ink to write with.*] Grind indigo with honey mixed with glair of eggs or glue-water, made of isinglass dissolved in water and strained.

*To make red writing ink of vermillion.*] Grind vermillion well upon a porphyry stone, with common water; dry it and put it into a glass vessel, to which put urine, shake all together, let it settle, then pour off the urine, and putting on more urine, repeat this work eight or ten times, so will the vermillion be well cleansed; to which put glair of eggs to swim on it above a finger's breadth, stir them together, and settling abstract the glair; then put on more glair of eggs, repeating the same work eight or ten times also, to take away the scent of the urine: lastly, mix it with fresh glair, and keep it in a glass vessel close stopped for use. When you use it, mix it with water or vinegar.

*To make printer's black.*] This is made by grinding the best lamp black with liquid varnish, and boiling it a little, which you may make thick at pleasure. You must make it moister in winter, than in summer; and note, that the thicker ink makes the fairer letter. If it be too thick, you must put in more linseed oil, or oil of walnuts, so may you make it thicker or thinner at pleasure.

*To make red printing ink.*] Grind vermillion very well with the aforesaid liquid varnish or linseed oil.

*To make green printing ink.*] Grind Spanish green with the said varnish or linseed oil as aforesaid; and after the same manner, may you make printer's blue, by grinding azure with the said linseed oil.

*To make red soft wax.*] Take white bee's-wax one

pound, turpentine three ounces, vermillion in powder well ground, oil olive, of each one ounce, melt the wax and turpentine; let it cool a little, then add the reſt, beating them well together.

*To do the ſame otherwiſe.*] This is done by taking away the vermillion, and adding inſtead thereof red lead three ounces, to the former things.

*To make green wax.*] Take wax one pound, turpentine three ounces, verdigriſe ground, oil olive, of each one ounce; complete the work as before directed.

*To make black wax.*] Take bee's-wax one pound, turpentine three ounces, black earth, oil olive, of each one ounce; mix and make wax as aforeſaid.

*To make wax perfumed.*] This is done by mixing with the olive aforeſaid, muſk, ambergriſe, or any other eminent perfume, as oil of cinnamon, adeps roſarum, or the like, one drachm, more or leſs, according as you intend to have its ſcent extended.

After the ſame manner you may make ſoft wax of all colours, having what ſcent you pleaſe; by mixing the ſcent intended, with the oil olive, and putting the colour in, in place of the vermillion.

*To make hard ſealing wax.*] Take pure fine gum-lack, melt it in an earthen veſſel, and put into it a ſufficient quantity of the colour you deſign your wax to be of, ſtir and mingle it well, then take it off the fire, and when it is a fit heat, you may make it up into rolls or ſticks. To make red wax, you muſt colour it with vermillion. Blue wax, with blue bice, ſmalt, or ultramarine. Green wax with green bice, verdigriſe, or ſome other mixture of that colour. Black wax, with ivory or cherry ſtone black. Purple wax, or of a dark red, with prepared caput mortuum, Indian lake, &c.

*A ſtrong glue for pipes and aqueducts.*] Tobacco pipe clay, dried and reduced to powder, and mixed with good flore of ſhort flocks, and beat up with linſeed oil to a ſtiff paſte, like kneaded dough, makes a ſtrong and a laſting cement for pipes and aqueducts; and being made into pipes (though long a drying) is very ſtaunch and laſting.

*To make a very ſtrong glue.*] Soak the fineſt ichthyocolla (that is iſinglaſs) twenty-four hours in ſpirit of wine, or common brandy; then boil all very gently together, continually ſtirring of it, that it burn not, ſo long till it becomes one liquor or body (ſave ſome ſtrings not very diſſolvable) which ſtrain whilſt hot, through a coarſe linen cloth, into a veſſel where it may be kept cloſe ſtopped; a gentle heat will melt this glue into a tranſparent liquor, with which you may glew things ſo ſtrongly together, that they will rather break in any other part, than in the place glued; it much exceeds the common glue.

*To make artificial pearls.*] Take ſublimate two ounces, tin-glaſs one ounce, mix them, and ſublime them together, and you will have a ſublimate not inferior to the beſt orient pearls in the world, of which, with glair, you may form what you pleaſe.

END OF THE SECOND PART.

# THE GOLDEN CABINET:

BEING THE

# *LABORATORY,*

OR

# HANDMAID to the ARTS.

CONTAINING

Such *Branches* of *Useful Knowledge*,

As nearly concerns all Kinds of People,

From the SQUIRE to the PEASANT:

AND WILL AFFORD BOTH

PROFIT and DELIGHT.

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PART THE THIRD.

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*PHILADELPHIA:*

PRINTED AND SOLD BY WILLIAM SPOTSWOOD,

AND H. AND P. RICE, MARKET-STREET.

1793.

THE

# SCHOOL of ARTS.

## Of the nature and compoſition of GLASS: and the art of counterfeiting Gems of every kind.

## PART THE THIRD.

### *Of Glaſs in general.*

BY glaſs, as here treated of, is to be underſtood, the artificial vitrifications of bodies, made to anſwer ſome uſeful purpoſe, either in domeſtic neceſſaries, or other articles of commerce: and the obſervations and directions given with regard to it, in this treatiſe, are ſuch only as reſpect the improvement of the art of preparing and compounding the kinds applicable to theſe ends in the different manufactures of it. For the more ſpeculative and philoſophic diſquiſitions on its nature are avoided, where they lead to no principles that are capable of being applied to practice. The methods of modelling and forming it into all the variety of veſſels, and other figures, into which it is wrought are likewiſe omitted: becauſe they are already, or may be by other means, well known to thoſe who have any any concern with them as an employment; or like all other occupations of artiſans, may be much more eaſily and better learned by ſuch as are deſirous to be initia-

ted into an operative knowledge of them, from an inspection of actual works, and trials to imitate what is there to be seen done, than they can by the most explicit verbal directions.

The manufactured glass at present in use may be divided into three general kinds, white transparent glass, coloured glass, and common green or bottle glass. Of the first kind, there is a great variety of sorts, according to the several purposes intended to be served by it, either for making domestic utensils, or lights for inclosed places: and of the second, there is likewise a still greater multiplicity of species, differing in their colour, or other properties, according to the occasions for which they are wanted: but of the last, there is no distinguished difference of sort; except what the accidental manner of preparation and management, practised according to the skill or art of particular directors of manufactories, may occasion.

In order, however, to speak more intelligibly of the nature of the manufactured glass, to be here treated of, it is proper to give some distinct notion of vitrification in general. But I shall not endeavour to push the matter to those almost metaphysical lengths to which Becher, Stahl, and others, have endeavoured to carry it; even far beyond the conclusions which can be supported by inductions from sufficient experiments. Vitrification then (according to the more general and obvious notions of its nature) is a change which may be wrought in most kinds of fixed bodies, or rather in all under some circumstances, by the means of heat, applied in various degrees, according to the various nature of the bodies: from which change, they become fluid; and continue so while kept in the same, or any greater degree of heat; and, when become cold, acquire transparency, fragility, a great but not absolute degree of inflexibility, a total want of malleability, and insolubility in water. All these qualities are inseparably attendant on perfect vitrification: though there may be many preparations of artificial glass, even among those that are in common use, in which some of them are wanting.

But this is, nevertheleſs, only where the vitrification is immature; or where there is an admixture of other bodies with the vitrified matter: as in the caſe of the opake white glaſs; in which the matter giving the milky colour is in an unvitrified ſtate, and conſequently deſtroys the tranſparency; or, in the compoſitions where too great a proportion of ſalts is uſed, when the glaſs produced will be ſoluble in water, though perfect with reſpect to all the other qualities. In both theſe caſes there is the preſence of an heterogenous body, beſides the proper glaſs; and therefore, if the whole maſs be conſidered as if in a vitrific ſtate, it muſt be deemed to be an imperfect one, though the compoſition, in the inſtance of the white glaſs, be adapted by this very circumſtance to the œconimical purpoſe for which it is intended. The ſame principle will be verified on a due examination in all the other ſorts of manufactured glaſs, as well as in accidental commixtures, where the appearances of the glaſs diſagree with the ſyſtem of qualities required, in the above given definition, to the perfect conſtitution of glaſs.

From the nature of vitrification, it therefore appears, that all fixed bodies are capable of being the materials of perfect glaſs under ſome circumſtances. But as the means of vitrification are limited with regard to the manufactured glaſs, ſuch bodies only are proper to become the ingredients of the perfect kinds of it, as are eaſily to be procured in due quantity, and admit of being vitrified by the heat of a furnace either alone, or by their commixture with others, which may promote this change in them: and in the caſe of the imperfect ſorts, ſuch as that above-mentioned, bodies that are not capable of being vitriated, by the means there employed, are alſo taken in as materials: where they are required to give the particular properties wanted in each peculiar ſort. The principal ſubſtances, therefore, that are choſen for the compoſition of manufactured glaſs, are ſand, flints, and other foſſible bodies of a ſtony and earthy texture; metals and ſemi-metals of all kinds previouſly prepared by calcination, or other operations; arſenic and zaffer,

which are prepared parts of a foſſile; and all ſalts of a fixed kind.

Among theſe ſubſtances there are ſome which are ſtrongly reluctant to the vitreous fuſion, and could ſcarcely alone be ever converted to glaſs; at leaſt not by the heat of any furnaces; and yet are ſuch, as are moſt capable of giving firmneſs and tenacity to that in which they are admitted; as alſo of being more copiouſly provided at a ſmall expence. There are others, on the contrary, that vitrify in a much leſs heat than that commonly employed in the working of glaſs; and have likewiſe this attendant property along with their own proneneſs to vitreous fuſion, that they accelerate and produce it in many of thoſe that are otherwiſe more repugnant to it; and cauſe them, by their commixture, to vitrify in a greatly leſs degree of heat than they otherwiſe would. This property of promoting vitrification is called technically fluxing the bodies on which they ſo act; and on the proper application of this principle to practice lies the main ſtreſs of ſkill in the art of compounding glaſs; as the ſavings in the original coſt of the ingredients, in time and in fewel, as well as the qualities of the glaſs produced, depend chiefly on the thorough intelligence, in this view, of the nature of the bodies, proper to become ingredients of it. The next important relation, in which bodies ſtand with reſpect to the compoſition of glaſs, is the effect they may have on its colour by their admixture: in order to deſtroy all kinds of which in ſome caſes, and to produce them in others, ingredients are frequently added, that are not otherwiſe neceſſary; as being no way ſubſervient to the general view. This conſtitutes, therefore, the other great object of ſkill in the art of making glaſs: for the knowing properly how to take away all colour from the tranſparent white glaſs, and to impart any kind deſired, to proper compoſitions on other occaſions, is of the next great moment to the being able, by the moſt cheap and eaſy means, to procure a due vitrification.

According to the above ſpecified intentions, in which the ſeveral ſubſtances ſerving for the materials of glaſs

are used, they may be properly distinguished into three kinds, as making the body, flux, and colorific matter.

The substances which have been employed in forming the body of glass are sand (by which is only to be understood the white kinds) flints, talc, spar, and several other stony fossiles. All these vitrify of themselves too slowly, to produce perfect glass by the degree of heat that can be applied to them when in larger masses: which makes them therefore require the addition of those other kinds, whose fluxing power may remedy this defect in them: while they, on the other hand, being of low price, and to be procured in unlimited quantities, and giving that hardness, strength, and insolubility, which cannot be had in any glass, formed of other substances without them, are yet essential and indispensibly necessary ingredients in all kinds of manufactured glass.

The substances which are used as fluxing ingredients in glass, are red-lead, pearl-ashes, nitre, sea-salt, borax, arsenic, the scoria of forges, commonly called clinkers, and wood-ashes, containing the calcined earth and lixiviate salts, as produced by incineration. The presence of some of these bodies is always equally necessary with that of those which form the body, in all the compositions of manufactured glass. But the use of them, both with respect to choice and proportion, is greatly varied in different works; even where the same kind of glass is intended to be produced: as the general nature of them has never been hitherto understood by the directors of such works; and they have only implicitly followed the best receipts they could procure, carefully keeping them secret, when they happened either by communication or their accidental discovery to be possessed of such improvements, as gave them any advantages over their fellow operators.

The substances which have been applied as colorific matter in manufactured glass, are extremely numerous and various; as all the species of metals and semi-metals, with many other mineral and fossile bodies, have been used for the producing some colour or other; and make a large field of speculative and practical knowledge.

The art of staining glass, with all the variety of colours in the greatest degree of force and brightness, is not however of so much importance commercially considered, as the knowing how to banish and exclude, with ease and certainty, the colours which of themselves arise in most of the compositions for glass intended to be perfectly transparent and colourless. For this last purpose, nitre and magnesia are the principal substances employed, in the manufactures of G. Britain; and extremely well answer the end: though not without enhancing the expence of the glass by the use of the first; and in a small degree injuring its transparency by that of the latter; as may be demonstrated by principles that are unquestionable in themselves, though wholly unknown to those who are practically concerned in these matters.

From these three kind of substances, duly combined together by commixture and adequate heat, or in some cases from the two first only, all the sorts of manufactured glass at present in use are formed. The general manner of doing which, is to reduce those kinds of bodies, that are in grosser masses, to powder; and then, all the ingredients being thoroughly well mixed together by grinding, and put into proper pots, to place them in a furnace where the heat is sufficient to bring them to a due state of fusion; in which they are to be continued till the vitrification be completed.

This proper degee of vitrification must be distinguished by the transparent and equal appearance of the matter, when a small portion is taken out and suffered to cool: except in the case of those sorts where the glass is not perfect, with regard to which, a judgment must be made from their having attained or wanting that peculiar appearance, which the particular sort is required to have. It may be proper to subjoin, that in all cases, the vitrification is sooner and more easily made perfect in proportion as the ingredients are reduced to the state of a finer powder, and more intimately commixt.

*Of the materials serving for the body of glass.*] The materials employed to give a body to glass, are sand,

flints, talc, ſpar, and ſome other ſtony and terene foſſiles.

Sand is, at preſent, almoſt the only kind of ſubſtance which is uſed in this intention in the Britiſh manufactures of glaſs; and with great reaſon, as it extremely well anſwers the purpoſe; and does not demand the previous preparation of calcination, that is neceſſary with reſpect to flints and other ſtones; and as it can be with certainty procured in any quantity demanded. The kind of ſand moſt fit for making the white tranſparent kinds of glaſs, is that brought from Lynn in Norfolk, by the name of which place it is diſtinguiſhed: and there is alſo another kind of this, but inferior, brought from Maidſtone in Kent. It is white and ſhining; and examined by means of a microſcope, appears to be ſmall fragments of rock cryſtal; from which it does not ſeem, by any experiments, to differ in its qualities; and the glaſs formed of it may, therefore, properly be conſidered as made of cryſtal. The introduction of the uſe of it into the manufactures of glaſs in this country has almoſt wholly ſuperſeded that of flints: from which it no way differs in this application, but in the being ſomewhat ſlower in vitrifying; which makes it require in proportion a greater ſtrength of flux and fire: but to compenſate for this diſadvantage, it is clearer in its own colour, and much freer from heterogeneous tinging bodies, which injure the colour of the glaſs; and frequently give embarraſſment where flints are uſed. The ſand requires no previous preparation for common and groſſer purpoſes; eſpecially where nitre is uſed; which burns out the ſulphureous matter from any filth of the nature of animal and vegetable ſubſtances; and conſequently calcines them to an earth no way injurious to the glaſs: but for nicer purpoſes, and where no nitre is uſed, it is proper to purify or cleanſe the ſand by waſhing: which may be thus done. Pour water upon it; and, having ſtirred them well about, incline the veſſel immediately, in ſuch manner, that the water may run off, and carry with it the filth that will float in it: by repeating which a few

times, the ſand will be freed from all the heterogeneous matter that is lighter than itſelf. For coarſe glaſs, other kinds of ſand of a ſofter texture are uſed: as, beſides the advantage of being cheaper, they are more eaſily vitrifiable than flints; and conſequently make a ſaving in the fluxing bodies which are to be added to them.

Flints are the next important article in the ſubſtances which are uſed for forming the body of glaſs; and where indeed the only kind employed in larger works, where any better ſorts of glaſs were manufactured, before the uſe of the white ſand excluded them in all places where it is to be conveniently obtained. Since, for the reaſons above given, it is a more eligible material, unleſs for experiments, or where very ſmall quantities are required; in which caſe the calcined flints being more eaſily reduced to an impalpable powder, may poſſibly be more commodiouſly employed than the ſand. Flints yet, however, continue to be uſed wherever the proper ſand cannot be procured at a reaſonable charge, as the ſole ingredient for forming the body of the better kind of glaſs: ſince they are, in moſt places where they are naturally found, to be had in extreme great quantities; and the expence of calcining them does not enhance their whole coſt to a degree beyond what the current price of glaſs may bear. The goodneſs of flints with reſpect to this uſe of them muſt be diſtinguiſhed by their clear tranſparent black colour; and all ſuch as are marbled with brown or yellowiſh colour ſhould be rejected, for fear of iron, which frequently lurks in them under that appearance, and is very injurious to the colour of glaſs if it get admiſſion into it. Such ſhould, therefore be carefully picked out when found in parcels of the clearer ſort; but if the greater part of any parcel appear ſo marked, it ſhould not be uſed till trial be made in a ſmall quantity, whether the diſcolouring be owing to any ſubſtance detrimental to the colour of glaſs or not. It is always neceſſary, that flints ſhould undergo a calcination before they be uſed in the compoſition of glaſs: as well becauſe they are not otherwiſe to

be reduced to a texture, which will admit of their being powdered, in order to their due commixture with the other ingredients; as becauſe they are not ſuſceptible of vitrification till a proper change may be produced in them by calcination. This calcination muſt be performed by putting them into a furnace of a moderate heat, being firſt dipped in water; and continuing them there till they become entirely white, even to the moſt interior part: which will require a greater or leſs time, according to their magnitude, and the degree of heat of the furnace. When they are thus rendered white, they muſt be taken out of the fire; and inſtantly immerſed in cold water; where they muſt remain, till they be again cold: and then they will be found, if duly calcined, to be cracked and ſhivered into flaky pieces; and to become ſo ſoftly brittle as to be eaſily reducible to powder. Some part will nevertheleſs be always found inſufficiently calcined; which may be diſtinguiſhed by their harder and more obdurate conſiſtence: and they muſt be carefully ſeparated, in order to be re-calcined; as they will otherwiſe greatly retard and impede the powdering of the duly calcined parts. Theſe which are properly calcined muſt then be levigated, by means of mills or other implements, accordingly as the quantity or opportunity may make it expedient; and they will then be fit for uſing in the compoſition for glaſs.

Talc of various ſpecies has been likewiſe uſed in the ſame intention as ſand and flints: but ſeldom in large works. It ſometimes requires a calcination, in order to its due preparation for entering into the compoſition of glaſs: but neither ſo great a heat, nor the quenching in cold water, are neceſſary for bringing it to a proper texture to bear powdering. Some ſorts of talc are much more quickly vitrifiable than others; and, fuſing eaſily with either ſalt of tartar or lead, may therefore be uſed in default of flint, or ſand ſufficiently white. But, with reſpect to larger manufactures, the uſe of flints is more eligible; as they are to be procured in great quantities with more certainty; and will, in

general, require much less flux and fire to bring them to a due state of vitrification.

Several other, both earthy and stony, fossiles have been likewise used for forming the body of glass: and it has been observed, that most kinds of stony substances, which will scintillate or strike fire with steel, are vitrifiable within the degree that fits them for this purpose. But as they are neither used at present, nor promise to be any way advantageous in practice, as far as is hitherto known of them, I shall omit enumerating them; as being foreign to the purpose in hand: except with respect to two kinds. The one of these is called *meilon* by the French; and is found in great quantities, as an upper crust in many freestone quarries: and, as it may be used without any previous preparation, and is very quickly vitrifiable, may be serviceable, on some occasions, to those who may want to form glass, or vitreous compositions, where this may be procured with more ease than any of the before-mentioned substances. The other is the white round semi-transparent river pebbles, which vitrify very soon; and, if chosen colourless, make a very white glass; but they must be calcined, as the flint, by putting them into the fire till they be red hot; and then quench them in cold water, in order to bring them to a state fit to undergo powdering.

Kunckel confounds the calcined flints, and all other stones used for making glass, under the name of sand, in his receipts; notwithstanding he admits of a great difference in their readiness to be vitrified: as in the case of calcined flints, and the softest kind of natural sand; where one hundred and forty pounds of salt are required to a hundred and fifty pounds of the calcined flints, and only one hundred and thirty pounds of salt to two hundred pounds of the sand.

*Of the materials used as fluxes in the composition of glass.*] The materials used for the fluxes in the composition of manufactured glass, are, lead, pearl-ashes, nitre, sea salt, borax, arsenic, smith's clinkers, and wood-ashes,

containing the earth and lixiviate falts as produced by incineration.

Lead is the prefent moft important flux in the Britifh manufactures of what is called flint glafs: but it muft be brought, by previous calcination, to the ftate of minium, or what is called red lead. This, ufed in a due proportion, makes a tougher and firmer glafs than can be produced from falts alone: and is yet procured at a very fmall expence. But all the glafs formed of lead is tinged originally with yellow; and therefore requires the addition of nitre to burn and deftroy the fulphur or phlogiftic matter it contains, in order to bring it to a more colourlefs ftate: which addition of nitre enhances again the coft of glafs fo compofed, that would otherwife be extremely low. There is another reafon, likewife, for the addition of nitre, or fome other falt, to operate as a flux in the glafs compounded with lead; which is, that there may not be a neceffity of ufing beyond a certain proportion of it. For, if glafs have much lead in its compofition, it will fuffer a corrofion by the air; which gives a greyifh dulnefs to its furface, that is very injurious both to its beauty and utility. It is needlefs here, to teach the manner of calcining lead; becaufe it is done in works appropriated to that purpofe; and is fold by the proprietors of thefe works, at a cheaper rate than any particular perfons could pretend to manufacture it for their private ufe. The perfection of red lead lies in its being thoroughly well calcined; which is beft diftinguifhed by its rednefs, inclining to crimfon, and in its being pure; which may be adjudged of by the brightnefs of its colour. There is indeed no materials of a red colour cheap enough to adulterate it with, except powdered bricks, or fome of the red okres; and they would immediately fhow themfelves, in the vitrification of the fmalleft quantity, by the ftrong yellow tinge they would give the glafs.

Pearl-afhes is the next leading article among the fubftances ufed as fluxes in glafs: and they at prefent moftly fupply the place of the Levant-afhes, the barillas of Spain, and many other kinds, which were formerly

brought here, as well for making glass as soap. In the kinds of glass, where perfect transparency is wanted, as in looking-glass plates, and all kinds of window glass, salts are preferable as a flux to lead; and, consequently, the pearl-ashes become the principal matter of the flux. For, as all the lixiviate or fixed alkaline salts of vegetables are the same for this purpose, when pure, and those called pearl-ashes are purer than any other which can be provided at a moderate expence, the use of them is more expedient than of any other. This kind of fixed alkaline salts, called pearl ashes, is prepared in Germany, Russia, and Poland, by melting the salts out of the ashes of burnt wood; and, having reduced them again to dryness, evaporating away the moisture, and calcining them for a considerable time in a furnace moderately heated. But, as they cannot be prepared with advantage in this country, (tho' in America they unquestionably might, and indeed are of late) and are to be had at a reasonable price by those who may have occasion to use them in making glass. I shall wave entering more particularly here into the detail of the process, by which they may be best and most profitably produced; as not properly falling within the intention of this work. The goodness of pearl-ashes must be distinguished by the equal and white appearance of them; as it consists in their purity, and their having been calcined for a long space of time, of which the whiteness, and equal appearance, are marks; unless in the case of some parcels that contain lumps of a bluish cast produced by the calcination; which discolouring is not, however, any proof of their being bad: but any brownish cast in particular parts, or greyness in the whole, is a certain criterion of their not being good. This must, however, be confined to such as are perfectly dry; which can only well be on the opening the casks they are brought over in: for, if the air have access to them, they soon deliquiate, and look brown or greyish, from a semi-transparency they acquire in that deliquiating state. There is one, and the most common adulteration, which is made in these salts, that is not easily

diſtinguiſhable by the appearance; it is, the addition of common or ſea ſalt, to them; which is ſometimes copiouſly made. This is not, however, very detrimental in the application of them to the forming glaſs. But it is, nevertheleſs, a diſadvantage conſiderable enough in large concerns, to buy one thing for another at ſix times its current price. As it is expedient, therefore, to know how to diſtinguiſh this fraud, the following method is propoſed as eaſy and certain.

Take a ſmall quantity of the ſalt ſuſpected; and, after it has lain in the air ſo as to be a little ſoftened but not melted, put it in a fire ſhovel and hold it over the fire where the heat is pretty ſtrong. If it contain any common ſalt, a crackling, and, as it were flight exploſion will follow, as the ſalt grows hot: which decrepitation is a certain mark of common ſalt wherever it is found.

The pearl-aſhes require no preparation; except where extreme great tranſparency is required, as in the caſe of looking glaſs, and the beſt window-glaſs; in which caſes a purification is neceſſary, in the manner which will be ſhown in ſpeaking of theſe particular kinds.

Nitre in its refined ſtate, in which it is commonly called ſalt petre, has been formerly much uſed as a flux in the finer kinds of glaſs; and is now likewiſe employed in moſt compoſitions of the ſame nature. But this is a noted one by thoſe who are at all acquainted with the principles of the art, ſo much in the intention of a flux, as in that of a colorific ingredient; from its power of rendering glaſs colourleſs, by deſtroying the phlogiſton in lead, or in any vegetable or animal matter, which may tinge the glaſs; as we ſhall have occaſion to obſerve more particularly in its proper place. As a flux, it is leſs powerful than fixed alkaline ſalts of vegetables: and being dearer by much, its uſe would, therefore, be in proportion leſs expedient than that of pearl-aſhes, if it were to be employed in this view only. The ſalt-petre that is uſed here, is brought from the Eaſt-Indies, in the form of what is called crude nitre; and in commercial language rough-petre: in which ſtate

it is commixt with some proportion of common salt. It is refined by persons who make it their proper business; and bought for the purposes of glass-making in the state of salt-petre: on which account, it is unnecessary to give the process for refining it here. If it be obtained in crystals of a such a size, that the figure of them may be distinguishable, there is no hazard of any adulteration, but what would be very apparent; as no heterogeneous matter can be made a proper part of such crystals; and, therefore, if they appear bright and colourless, the goodness cannot be doubted.

Sea-salt is also frequently used as a flux in the making glass of various kinds; and it has a very strong power in promoting vitrification even in some obdurate bodies; but, used in a large proportion, it does not produce so strong and tenacious a glass as lead, or even the alkaline salts of vegetables; and is therefore only taken in aid of the others, when admitted as an ingredient. It should be brought to a dry state by decrepitation: that is, keeping it in a moderate heat, till it ceases crackling, before it be put with the other ingredients into the fusing heat: otherwise, by the little explosive bursts of its parts, it will drive some of the powdered matter out of the pot. It must not, after such decrepitation, be again exposed to the air; for, if it be, it will regain its former quality of crackling in a short time.

Borax is the most powerful flux of all the salts, or, indeed, of any known substance whatever: but, on account of its great price, can only be admitted into the composition of glass designed for looking-glass plates, or other purposes, where a considerable value can be set on the produce; or where the quantity wanted is very small. It is brought from the East-Indies, under the name of tincal; and the refinement of it in a perfect manner is hitherto known but to few persons in Europe, who carefully keep it secret. The knowledge of it, however, is not important to the art of making glass; as it is always procured for that purpose in a refined state; and not used in very large quantities. The purity of it may be ascertained by the largeness and clearness of

the cryſtals: for when it is had in that ſtate, it may be always concluded good. The previous preparation of borax for the compoſition of glaſs, is to calcine it with a gentle heat, which converts it to a flaky feathery kind of ſubſtance like calcined alum: after which it ſhould be ground to powder, and is then fit to be commixt with other ingredients. This calcination of borax ſhould be with a gentle heat, and in a very large veſſel proportionably to the quantity; for it ſwells and riſes in inflated bladders, ſo as to occupy a very great ſpace.

Arſenic is alſo a powerful flux; but muſt not be added, nevertheleſs, in too great quantity. For though when once vitrified perfectly, it greatly promotes the ſame change in other ſubſtances, yet, when added in a redundant proportion, it turns the glaſs milky or opake; and keeps it in that ſtate a conſiderable time before it will duly aſſimilate; from whence the due vitrification is greatly retarded, ſo as to occaſion an intolerable loſs of time and fewel. Though the glaſs in all ſuch caſes would become clear, if continued long enough in the fire, yet, on this principle of its flowneſs in vitrifying when added to compoſitions of glaſs in a large proportion, it is uſed for giving an opake white colour to glaſs as we ſhall ſee below.

Wood aſhes, by which is to be underſtood, likewiſe, thoſe of broom, furze, or any other burned vegetable, are uſed as a flux for the common bottle or green glaſs. The aſhes muſt be taken in their original ſtate, conſiſting of the calcined earth of the vegetable, and their lixiviate or fixed alkaline ſalt; as their virtue lies in their original manner of commixture: for this very extraordinary circumſtance attends them, that though in their primitive ſtate they vitrify eaſily, and act as ſtrong flux to any of the vitrifiable earths or ſtones; yet, if the ſalts be ſeparated from the earth, by ſolution in water, the earth from that time becomes extremely repugnant to vitrification; and though the ſame ſalts which were taken away from it, or even a much larger quantity be again added to it, it reſiſts their fluxing power, and diſplays a nature entirely different from that

which it appeared to have before its separation from the salts. There is no preparation necessary for these ashes, in order to their entering into the composition of glass, except the sifting them to free them from all the fragments of charcoal, or unburned parts of the vegetables employed in their production: but they should be carefully kept from damp and moisture; which would make the salts deliquiate, and run off from the earth. The goodness of these ashes must be distinguished by their appearing free from impurities, and by their whiteness; and their abounding in salt is, likewise, a proof of their excellence; which may be examined, by making a lixivium of any known small quantity, and judging of its strength by its weight.

*Of the materials used to make glass colourless.*] As the substances used for producing the various colours in glass, will more properly come in question, when I treat particularly of that art, I will omit speaking of them here, and only at present enquire into the nature of nitre and magnesia, which are two ingredients used for rendering the glass colourless, that is intended to be so: and which, indeed, is the kind much the most generally useful, and what makes the only subject of great manufactures.

The general nature of nitre, or salt-petre, has been before observed in speaking of it as a flux; and it only remains to explain that quality of it, by which it operates in destroying the colour in those compositions of glass, where it is used for that purpose. This quality is, the power of ascending and supporting in a combustible state all bodies, which contain phlogistic and sulphureous matter, if they be brought in contact with it, in a certain degree of heat; by which means such sulphureous or phlogistic matter is destroyed. Or, in other words, it has the same combustible power with the air in making bodies burn till they be reduced to the state of a calx. In this intention, therefore, salt-petre is made an ingredient in those compositions for transparent colourless glass, where lead is used as a flux: for such glass, having, otherwise, a strong tinge of yellow

from the phlogiſton of the lead, requires, conſequently, the deſtruction of the phlogiſton, at leaſt to a certain degree, in order to its being freed from this tinge. This operation of the nitre on the lead, is moſt obviouſly apparent, if a piece of ſalt-petre be thrown into melted glaſs formed of lead: for a detonation or explosive effect immediately ſhows itſelf: and continues till the acid contained in the ſalt-petre be conſumed.

The diſtinct knowledge of this principle clearly points out in what compoſitions of glaſs, nitre is neceſſary; and, in ſome degree, what the proportions may be in which it ſhould be added to each kind: as ſuch proportion muſt be regulated by the quantity of phlogiſton to be deſtroyed. For, as has been before obſerved, conſidered merely as a flux, it is dearer than the pearl aſhes, without any advantage, but the being ſomewhat more void of colour. This is obvious, as it is not only of double the price, but weaker in its action, unleſs where meeting with phlogiſtic matter in any of the other ingredients, it be deprived, as was above intimated, of its acid ſpirit; and converted, as it then will be, to exactly the ſame kind of fixed alkaline ſalt, with the pearl-aſhes themſelves: but in the proportion of only one-third of its original weight. In glaſs formed of lead, therefore, the uſe of nitre is abſolutely neceſſary; and, in glaſs of ſalts only, where the colour is to be entirely deſtroyed, and great tranſparency is wanted, as in the caſe of looking-glaſs, and ſeveral other kinds of plates, it is alſo requiſite in a leſs proportion. For, tho' the appearance of any ſlight yellow tinge may be taken away by the uſe of the magneſia; yet that (for the reaſon we ſhall ſee below) is always attended with a proportionable loſs of the tranſparency.

Magneſia is the other ſubſtance employed for rendering glaſs colourleſs. It is a foſſile, that partakes of the nature of iron ores; but does not contain any conſiderable quantity of that metal, and ſometimes only a very little. It is found in almoſt every country amongſt other iron ores: and frequently, alſo, above the beds of lead ore; where, indeed, the beſt ſeems to have

been always found; probably from its being leſs replete with iron, than ſuch as is found in the beds of that metal. The hills near Mendip, in Dorſetſhire, have particularly afforded extremely good. It is not of any peculiar ſhape or figure, but ſomewhat ſtriated like antimony in its texture; and of a browniſh black colour like ſoot. The marks of its being good, is the deepneſs of the colour, and the being free from ſpecks of a metalline appearance, or a lighter caſt: and that ſhould be particularly rejected, which has ſpots of a reddiſh brown, or yellowiſh colour, as being ſigns of the preſence of iron.

When fuſed with glaſs of any kind, it readily vitrifies, and tinges the glaſs of a ſtrong reddiſh purple colour, but not clear and bright. In conſequence of this quality, it is uſed for deſtroying any ſlight yellowiſh or greeniſh tinge in glaſs, that is required to be colourleſs, on the following principle. The three primitive colours of yellow, red, and blue, when mixed in due proportion, deſtroy each other; and produce the effect of grey, in the caſe of opake bodies; and of black, in ſuch as are tranſparent. Now the tinge of magneſia in glaſs being purple, which is a compound of blue and red, and being added to the greeniſh or yellowiſh tinge of the glaſs, conſequently deſtroys the appearance of it; eſpecially the greeniſh, as the proportion of red in it is greater than that of the blue: but a proportion of black being produced, the glaſs is obſcured in the ſame degree, though not ſo as to be perceptable to the eye, without comparing it with ſome other more pellucid. This is a reaſon for uſing the magneſia ſparingly, or rather avoiding it entirely, in thoſe compoſitions of glaſs, where great tranſparency is demanded; and for forming them of ſuch ingredients as are moſt colourleſs, or may be rendered ſo by the uſe of nitre. Magneſia requires to be well calcined in a hot furnace; and then to undergo a thorough levigation: for it ought to be in the ſtate of an impalpable powder, in order to its perfect commixture with the other matter. It was formerly practiſed to quench the magneſia ſeveral times

in vinegar, after reiterated calcinations; with a view of freeing it from any iron that might be mixed with it: but this was needleſs; and is now entirely diſuſed. Its application to the colouring glaſs, in which it is very efficacious for many purpoſes, we ſhall ſpeak of in its proper place.

*Of the inſtruments and utenſils employed in the compoſition and preparation of glaſs.*] The inſtruments and utenſils employed in the compounding and preparing glaſs are of two kinds: as they are ſubſervient to two different purpoſes: the levigation and commixture of the ingredient; and the fuſion or vitrification of them.

The inſtruments ſubſervient to levigation, and the mixture of the ingredients, are horſe or hand-mills, mortars and peſtles, and flat ſtones and mullars.

The horſe, or hand-mills, may be ſuch as are uſed for other purpoſes: but the ſtones ſhould be of a very hard texture, in order that as little as poſſible of the matter of them may be abraded and commixt with the glaſs.

Where large mortars are uſed for ſuch ingredients as are not employed in a ſufficient quantity, to make it commodious to grind them in mills, they ſhould be of caſt iron, with peſtles of the ſame; and ſhould be carefully kept from ruſt. But for very nice purpoſes where the quantity of the matter is ſmall, mortars ſhould be had of bottle or green glaſs, or of flint or agate, as alſo a ſtone and mullar of porphyry or agate, for levigating the calces of metals, or other ingredients uſed in colouring glaſs.

Searces or ſieves of fine lawn ſhould likewiſe be provided, for ſifting ſome of the levigated ſubſtances. They ſhould be like thoſe of the apothecaries and druggiſts, with a cover fitted to the upper part; and a box to the under, for preventing that waſte of the matter which attends the ſifting in the open air.

The utenſils employed in the fuſing or vitrifying the matter of glaſs are, furnaces, with the proper iron works; pots for containing the compoſitions when put into the fire: with the iron inſtruments for ſhifting the

matter from one to the other, in case of accident; and for taking out small portions, to judge of the progress of the vitrification, and the qualities of the glass.

The structure of the furnaces for preparing and working glass in large, is so well and commonly known, that it is needless to enter into the detail of it here. Where smaller quantities are prepared, as in the case of coloured glass, or pastes in imitations of stones, the common wind furnace, or the athanor of the chemists may be used; or a furnace may be made for this particular purpose, which may be constructed in the following manner:

Mark out a circular area of one yard diameter; and let a cylindrical building be raised upon it of good stock bricks, and coal-ash mortar, of the height of twelve inches. This cylinder must have an hollow area in the middle, of a round form, twelve inches in diameter; the rest of the space being filled with solid brick-work. But an opening must be left in the front at the bottom, which must be six inches broad and four high, for taking away the ashes; and it should likewise have an iron frame and door, like those commonly used for feeding the fire in furnaces, that it may be occasionally closed, in order to check or extinguish the fire. This cylindrical fabric being raised to the height of twelve inches, a grate for bearing the fuel, composed of a strong iron ring with bars let into it, must be laid over the round hollow: and another cylinder, of the same diameter and thickness of wall, must be raised in like manner to the height of eight inches above the bars. But this should be done with Windsor bricks, and the mortar formed of Windsor loom, where they can be obtained; and care should be taken, likewise, that the brick work may have good hold of the rim of the grate. At the height of about five inches above the bars, a frame and door should be fixed for feeding the fire. The door should be about five inches high, and eight long; and should have a strong latch going across the whole breadth of it, by which it may be opened and shut. When the cylindrical hollow over the bars is thus car-

ried eight inches high, a larger area muſt be taken of twenty-four inches diameter; and the brick work muſt be carried up round it, in the ſame cylindrical manner as at firſt, for ten inches more; except, that four iron doors and frames of the ſame form with thoſe for feeding the fire muſt be fixed in the brick work. The dimenſions of theſe doors ſhould be twelve inches high, and eight in breadth; and the loweſt part of them ſhould be level with the flooring made by the brick work on enlarging the area of the cavity of the furnace; or, in other words, where the brick-work of this wider cylinder begins. Theſe doors ſhould be placed at equal diſtances from each other, and in ſuch manner, that the other for feeding the fire may be exactly in the middle betwixt the two neareſt to the front; and the chimney betwixt the others. A hole ſhould be likewiſe left for venting the ſmoke into the chimney, which may be ſix inches broad and three high: and after this the brick-work, may be brought together, in the manner of an arch, till the whole cavity be covered. For the whole of this upper part, Windſor bricks and Windſor loom ſhould be uſed, or, where they cannot be procured, ſuch other as are moſt like them in their quality of bearing intenſe heat, without either being calcined or vitrified. The manner of uſing this furnace is too obvious to require explanation; it being enough apparent that the flooring in the enlarged cavity is intended for the pots, or crucibles containing the matter; and the four doors for the more conveniently putting them in and taking them out. When, however, they are to be placed in the furnace, it ſhould not be on the parts before the doors; for fear the ſtream of cold air, on opening the doors occaſionally, may crack them. But they ſhould be conveyed through one of the doors to the oppoſite ſide, by means of an iron peel, formed like thoſe of the bakers; and put betwixt the doors on that ſide; by which means, they will not only be much ſafer, but will be out of the way of impeding the operator from ſeeing what paſſes in every part of the furnace: and, by this means, likewiſe, room may be found for many more pots and crucibles, than could be

introduced if the firſt four ſtood before the doors; and blocked up the entrance againſt any other. When this furnace is wanted for calcinations, or other operations that require leſs heat, the area of the cylinder ſhould be made leſs by bricks formed of Windſor loom and ſand, and adapted to the cylindrical figure of the cavity: which bricks may be eaſily put in, or taken out, by means of the four doors in the upper part, and that in the lower for feeding the fire. The dimenſions of this furnace are calculated to anſwer the purpoſe of thoſe, who may engage in theſe matters for profit; and may be enlarged, if there be yet occaſion: but for ſuch as meddle with them ſpeculatively, and in the view of experiments only, they may be proportionably contracted; as being much larger than needful.

The pots for containing the melted matter of the glaſs ſhould be formed of the clay uſed for making tobacco-pipes, or of the beſt potter's clay that can be procured. But as there are ſeldom any ſuch clay found, as will ſtand the drying and burning well, without the admixture of ſome earthy body, broken crucibles ground to powder, or, in default of them, white ſand, or calcined flints duly levigated, may be added. Near London the tobacco-pipe clay, or the Sturbridge clay, with a fourth or fifth of ground crucibles or ſand, are the beſt materials that can be uſed: but care ſhould be taken to free the clay perfectly from ſtones or gravel, and to incorporate the ground crucibles or ſand well with the clay. When the tobacco-pipe clay is uſed, it is previouſly calcined, and then ground to powder; and afterwards moiſtened with water, then well beat in the manner of mortar.

Small pots for making paſtes or coloured glaſſes may be formed on a wooden mould; and ſhould be ſlowly dried, and afterwards baked or burned, in a fire very gradually increaſed to a ſtrong degree, and then ſuffered to extinguiſh before the pots be taken out of the furnace. This may be done commodiouſly in a potter's kiln, along with earthen or ſtone ware. But the pots ſhould be placed in the hotteſt part of the furnace. They other-

wife may be burned, where other conveniences are wanting, commodiouſly enough in the furnace above-mentioned; and if intended to be uſed in ſuch furnace, the largeſt may be ſix inches diameter, and ten or twelve inches in height. However, they muſt be formed a little conical or narrower at the bottom than the top, that they may be the more eaſily drawn from the mould; which need only to be a piece of wood turned into the form and dimenſions of the cavity of the pot.

*Of the ſeveral kinds of white glaſs; and their compoſition in general.*] The ſeveral kind of white tranſparent glaſs now uſed in moſt parts of Europe are, the flint-glaſs (as it is here called) and the German cryſtal glaſs, which are applied to the ſame uſes and purpoſes;—the glaſs for plates for mirrors or looking-glaſſes;—the glaſs for windows and other lights;—and the glaſs for phials, and ſuch kind of ſmall veſſels.

Of each of theſe kinds there are ſeveral ſorts; ſome only differing in the particular compoſition and management of the directors of the works where they are manufactured, but alike in their price, and the uſes to which they are applied; and others, which are allowedly inferior ſorts, ſold at cheaper rates, and employed accordingly for coarſer purpoſes.

The ſeveral kinds of glaſs differ in the ſubſtances employed as fluxes in forming them, as well as in the coarſeneſs or fineneſs of ſuch as are uſed for their body. The flint and cryſtal, mirror, and beſt window glaſs, not only require ſuch purity in the fluxes, as may render it practicable to free the glaſs perfectly from all colour; but, for the ſame reaſon alſo, either the white Lynn-ſand, calcined flints, or white pebbles, ſhould be uſed. The others do not demand the ſame nicety in the choice of the materials; tho' the ſecond kind of window glaſs, and the beſt kind of phial, will not be ſo clear as they ought, if either too brown ſand, or impure ſalts, be ſuffered to enter into their compoſition.

*Of the nature and compoſition of flint glaſs; and the German cryſtal glaſs.*] Flint glaſs, is of the ſame general kind with what is in other places called cryſtal

glaſs. It had this name from being originally made with calcined flints, before the uſe of the white ſand was underſtood; and, though no flints are now uſed in its compoſition, it retains ſtill the name. This kind differs, however, from the German and other cryſtal glaſs, in being partly formed of lead; whereas the fluxing bodies employed for the others, are only ſalts or arſenic; and in having a white ſand (which as is ſaid before, appears to be fragments of cryſtal) for its body. Inſtead of which, calcined flints, or the white river pebbles, or other ſuch ſtones, are uſed for the cryſtal glaſs in other places: there being no ſand of this kind of equal goodneſs found out of England, as far as is hitherto known.

The compoſition of flint glaſs is, therefore principally the white ſand and lead; to which a due proportion of nitre is added, to burn away the phlogiſton of the lead: which otherwiſe imparts a ſtrong yellow tinge to the glaſs; and to this is added, for hiding the remainder of the colour, a ſmall quantity of magneſia: as alſo in ſome works a proportion of arſenic, to aid the fluxing ingredients. Flint glaſs is not, however, a ſimple glaſs of lead: for where no other ſalts are added, yet the quantity of nitre uſed being conſiderable, and fluxing a proportionable quantity of the ſand, it muſt be conſidered as a compound glaſs of ſalts and lead. But indeed it has been generally practiſed, to add ſome quantity of other ſalts to it; and diminiſh proportionably the quantity of lead otherwiſe neceſſary. This quantity, though great in the glaſs made ſome time ago, ſeems to be much diminiſhed in that manufactured lately; at leaſt in ſome works: as appears from the ſmall weight and tranſparency of what is now to be met with; as well as from the veſſels being blown much thinner, and of leſs ſubſtance, than the glaſs in which leads abound could well bear to be. The admiſſion of lead into glaſs renders ſuch glaſs leſs hard and tranſparent, than that made of ſalts only. But there is in glaſs of lead a power of reflecting the rays of light, of the ſame nature with that of diamonds and topazes, that gives a luſtre and brilliant ap-

pearance to veſſels of a round figure, not found in the mere glaſs of ſalts: where the too great tranſparency, and want of play, occaſions a poorneſs or deadneſs in the look, when ſeen by the other: and this likewiſe extends itſelf in ſome degree to the appearance of liquors contained in them. For polygonal veſſels however, or thoſe cut with flat ſides, or ſuch as are decorated with flowers, or other ornaments cut in them, or with gilding, the glaſs of ſalts is preferable; as may be obſerved in the inſtance of thoſe brought from Germany. This muſt not, nevertheleſs, be extended to ſuch pieces as are cut with a great number of angles for the parts of chandeliers, or other purpoſes where the play of the light is wanted: for in all ſuch caſes, the glaſs formed with lead again takes place of the other; as producing a greatly ſtronger and more beautiful effect, for the reaſons before given.

It appears from what has been ſaid, that flint glaſs may be, as in fact it is, formed of various compoſitions, by altering the quantities of lead and nitre, and adding equivalent proportions of other ſalts or arſenic: in conſequence of which, ſavings may be made in the expence, and a difference will ariſe in the hardneſs or ſoftneſs of the glaſs. For the more the quantities of nitre or other ſalts are increaſed, and that of the lead diminiſhed, the more hard and firm the texture of the glaſs will be; and ſo vice verſa. I will, therefore, give a recipe for the compoſition of a glaſs, according to each of the ſeveral manners, in which the proportion of the ingredients may be properly varied; and diſtinguiſh, likewiſe, in each caſe, what the abſolute and comparative qualities of the glaſs produced will be; and with reſpect to the comparative expence, the quantities of the ſeveral ingredients being thus ſtated, it will be very eaſy for thoſe who are acquainted with the market-price of them, to make a computation.

No. 1. *Compoſition of the moſt perfect kind of flint glaſs.*] "Take of the white ſand one hundred and twenty pounds, of red lead fifty pounds, of the beſt pearl-aſhes forty pounds, of nitre twenty pounds, and

of magnesia five ounces."—If this composition be fused with a very strong fire, and time be given to it, a glass will be produced, that will have the play of the best flint glass, and yet be hard and strong. It is not so cheap as the compositions below given, where arsenic or common salt is introduced, or where more of the pearl-ashes are used: in either of which cases, savings may be made, by diminishing proportionably the quantities of nitre. But the qualities of this glass will be found to come nearer to the standard of perfection: which is to unite the lustre and hardness together in the greatest degree, they are compatible with each other.

If this composition be, however, desired to flux with less heat and quicker, a powder or two of arsenic may be added: which will be found effectually to answer the purpose.

No. 2. *Composition of flint glass, with a greater proportion of salts.*] "Take of sand one hundred and twenty pounds, of red lead thirty-six pounds, of nitre twelve pounds, and of magnesia six ounces."——This will require much the same fire as the other: but will be harder in its texture; and have less of the refractive play of the light: it is, however, a very good composition of glass; and comes nearer to the kind now made: though I imagine the proportion of lead is still more diminished in some I have seen than here. If it be desired, to be made more yielding to the fire, arsenic may be added as is directed for the preceding; or the quantity of sand may be lessened; but in that case the glass will be softer and weaker.

No. 3. *Cheaper composition of flint glass with arsenic.*] "Take of white sand one hundred and twenty pounds, of the best pearl-ashes thirty-five pounds, of red lead forty pounds, of nitre thirteen pounds, of arsenic six pounds, and of magnesia four ounces."—This glass will require a considerable time in the fire to become clear, and must not, if it can be avoided, be strongly urged at first: for the arsenic is apt to sublime away, if the heat be violent before the other ingredients run into

fusion so as to detain it. It is well, therefore, to mix a considerable proportion of glass, which has been wrought before, and is to be manufactured over again with this composition when it is used; which, running sooner than the new mixed ingredients, will take hold of the arsenic, and fix it. This composition should, however, be afterwards fused, with a considerable heat; and continued in that state till the milky appearance of the arsenic, which it will sometimes retain for a long time, be entirely gone. For notwithstanding this apparent reluctance to perfect vitrification, the arsenic never fails at length to become very transparent glass; and even to contribute greatly to render the other ingredients so likewise. This glass will not be so hard as those of the above compositions: but it will be very clear, and may be employed for the formation of large vessels, where a sufficient thickness can be allowed to give them strength.

No. 4. *Cheaper compositions of glass by means of common salt.*] "Take the proportions of the other ingredients given in the last; and, omitting the arsenic, add in its stead fifteen pounds of common salt."—This will be more brittle than the last; and therefore cannot be recommended, unless for the fabrication of such kind of vessels, or other pieces, where the strength is of little moment.

No. 5. *Cheapest composition of flint glass, by the addition of arsenic and common salt.*] "Take of the white sand one hundred and twenty pounds, of red lead thirty pounds, of the best pearl-ashes twenty pounds, of nitre ten pounds, of common salt fifteen pounds, and of arsenic six pounds."—This glass will fuse with a moderate heat; but requires time, like the last, to take off the milky appearance of the arsenic; it is yet softer than the last; and may, therefore, be deemed the worst kind of flint glass that can be made, preserving the appearance of good glass to the eye; which it will have equally with any other when properly managed.

No. 6. *Composition of the best German crystal glass.*] "Take of the calcined flints, or white sand, one hun-

dred and twenty pounds, of the beſt pearl-aſhes ſeventy pounds, of ſalt petre ten pounds, of arſenic half a pound, and of magneſia five ounces."—If the pearl-aſhes be pure and good, this glaſs will equal the beſt of this kind that ever was made. Borax has been frequently uſed alſo in the compoſitions for this ſort of glaſs; but its great price, without any equivalent advantage, will deter from the employing it in large manufactures; as there is no ſort of tranſparent glaſs in common practice, that of which looking-glaſs plates is made excepted, can bear the expence of it

No. 7. *Cheaper compoſition of German cryſtal glaſs.*] "Take of calcined flints, or white ſand, one hundred and twenty pounds, of pearl aſhes forty-ſix pounds, of nitre ſeven pounds, of arſenic ſix pounds, and of magneſia five ounces."——This compoſition requires a long continuance of heat, on account of the arſenic, for the reaſon before given. It produces a glaſs equally, or more tranſparent and colourleſs than the preceding, but ſomewhat more brittle. The arſenic is, however, ſo diſagreeable an ingredient, from the deleterious qualities of the fumes, which will neceſſarily riſe copiouſly till the fuſion of the other ingredients check it, that, where the advantage is not more conſiderable than the ſaving ariſing from the difference of theſe two recipes, it is ſcarcely worth while to ſubmit to the inconveniencies of it.

*Of the nature and compoſition of the glaſs proper for plates for mirrors or looking glaſſes.*] The glaſs for forming the looking-glaſs plates in perfection, is the moſt nice and difficult kind to manage, of any whatever; there being no latitude, with reſpect to ſeveral of the qualities, as there is in the caſe of flint glaſs, without its goodneſs being really impaired. Theſe qualities are, to be entirely tranſparent and colourleſs; to have as little power of refracting the rays of light as poſſible; to be entirely free from bubbles, ſpecks and flaws, and to be fuſible with a moderate heat. Hardneſs of conſiſtence is of leſs conſequence in this kind of glaſs than in the flint; though it is an additional exceſſence; as

far as it may be had along with the other qualities: ſince the plates may, in that caſe, be wrought thinner with the ſame degree of ſtrength, which is a conſiderable advantage to mirrors made of them.

The white ſand is the proper ingredient for forming the body of this kind of glaſs, as well as of the flint: and the principal part of the flux ſhould be the fixed alkaline ſalt of vegetables; which the pearl-aſhes will beſt furniſh, when duly purified. This ſalt muſt, however, be aided by borax, or common ſalt; in order to facilitate the fuſion, and prevent the glaſs from ſtiffening in that degree of heat, in which it is to be wrought into plates. Lead is by no means a proper ingredient in the compoſition of this kind of glaſs; on account of its augmenting the refracting power; and for the ſame reaſon arſenic, which has the like effect, though in a much leſs degree ſhould be either omitted, or but ſparingly uſed. The ſand ſhould be carefully cleanſed for this uſe, by the means before directed for that purpoſe, and the borax ſhould be firſt calcined, and then rubbed to powder. The pearl-aſhes muſt likewiſe be purified for this uſe, which may be done in the following way:

*Manner of purifying the pearl aſhes.*] "Take any quantity of the beſt pearl aſhes, and diſſolve them in four times their weight of water boiling: which operation may be beſt performed in a pot of caſt iron. When they are diſſolved, let the ſolution be put into a clean tub; and ſuffered to remain there twenty-four hours or longer. Let the clear part of the fluid be then decanted off from the dregs or ſediment, and put back into the iron pot; in which the water muſt be evaporated away till the ſalts be left perfectly dry again. They ſhould then, if not uſed immediately, be kept in ſtone jars well ſecured from moiſture and air, till ſuch time as they are wanted."—Great care ſhould be always taken, in this treatment of the ſalts, to keep the iron pot thoroughly clean from ruſt, which would give the yellow tinge to the glaſs, not to be removed without greatly injuring it.

No. 1. *Beſt compoſition of glaſs for looking-glaſs plates.*] "Take of white ſand cleanſed ſixty pounds, of purified pearl-aſhes twenty five pounds, of ſalt-petre fifteen pounds, and of borax ſeven pounds."—This compoſition ſhould be continued long in the fire; which ſhould be for ſome time ſtrong, and afterwards more moderate, that the glaſs may be entirely free from bubbles before it be worked. It will be entirely clear of all colour, unleſs in caſe of ſome accident: but if any yellow tinge ſhould, nevertheleſs, unfortunately affect it, there is no remedy, except by adding a ſmall proportion of magneſia, which ſhould be mixed with an equal quantity of arſenic; and after their being put into the glaſs, giving it a conſiderable heat again, and then ſuffering it to free itſelf from bubbles in a more moderate one, as before. If the tinge be ſlight, an ounce of magneſia may be firſt tried; and if that prove inſufficient, the quantity muſt be increaſed; but the glaſs will always be obſcure, in proportion to the quantity that is admitted; though, perhaps, not in a degree that may prevent it from paſſing current with thoſe who do not examine with great ſtrictneſs. This compoſition is not to be made without expence, at the times when borax is dear; but the great price which looking-glaſs plates, particularly ſuch as are large, bear, will very well allow it: or even the adding a greater quantity of borax, when there is occaſion to have the glaſs run more eaſily, and roll in a leſs degree of heat.

No. 2. *Cheaper compoſition for looking-glaſs plates.*] "Take of the white ſand ſixty pounds, of pearl-aſhes twenty pounds, of common ſalt ten pounds, of nitre ſeven pounds, of arſenic two pounds, and of borax one pound."——This glaſs will run with as little heat as the former; but it will be more brittle, and refract the rays of light in a greater degree. It is, therefore, worſe than the other in a greater degree, than is balanced by the ſaving in an article, where the coſt of the materials is not conſiderable in proportion to the return; it being the work and ſkill, and not the prime expence of the ingredients, that make the high price of looking-glaſs

plates. It would be, consequently, unpardonable, while they continue to be sold at the present dear rates they bear in this country, to impair the quality of the glass, for the sake of a trifling saving out of the original price of the materials.

*Of the nature and composition of window-glass.*] In order to have window-glass in the utmost perfection, the same qualities and treatment are required, as for the looking-glass plates; and the same kind of glass is, therefore, used for lights, where the expence can be allowed. But as that is only done in extraordinary cases, inferior kinds of various rates of price are wanted for more common purposes; where not only the cost of grinding may be saved, but even the glass itself afforded cheaper, on account of its composition. The best of these kinds is called crown-glass: the composition for which may be as follows; the ingredients being previously prepared in the same manner as for the looking-glass.

No. 1. *Composition of crown (or the best window) glass.*] "Take of white sand sixty pounds, of purified pearl ashes thirty pounds, of salt-petre fifteen pounds, of borax one pound, and of arsenic half a pound."—This will be very clear and colourless, if the ingredients be good: and will not be very dear. It will run with a moderate heat; but if it be desired to be yet more fusible and soft, half a pound or a pound more of arsenic may be added. If the glass should prove yellow, the magnesia must be used, as above directed for the looking-glass.

No. 2. *Composition for a cheaper kind of window-glass.*] "Take of white sand sixty pounds, of unpurified pearl-ashes twenty-five pounds, of common salt ten pounds, of nitre five pounds, of arsenic two pounds, and of magnesia one ounce and a half."—This will be inferior to the above kind; but may be improved, where desired, by purifying the pearl-ashes. This operation will not only free them from the remaining part of the earth of the ashes they were extracted from: (which is

apt to give a small degree of opacity to the glass, as it will not vitrify in this state) but renders them also less liable to impart a yellow tinge to the glass; and, therefore, where the goodness of such ashes is known by trial, an ounce of the magnesia, or perhaps more, may be spared.

No. 3. *Composition of common or green window-glass.*] "Take of white sand sixty pounds, of unpurified pearl-ashes thirty pounds, of common salt ten pounds, of arsenic two pounds, and of magnesia two ounces."—— This is a cheap composition; and will not appear much green, nor be very deficient in transparency.

No. 4. *Cheapest composition of common or green window-glass.*] "Take of the cheapest kind of white sand one hundred and twenty pounds, of unpurified pearl-ashes thirty pounds, of wood-ashes well burned and sifted sixty pounds, of common salt twenty pounds, and of arsenic five pounds."—This composition is very cheap, and will produce a glass with a greenish cast; but greatly superior to what I have frequently met with: though nothing that will at all answer the end, can be well prepared at less expence.

*Of the nature and composition of the glass for phials.*] The glass of which phials for the use of apothecaries, ink-bottles, and many other such small vessels, are made, is a kind betwixt the flint-glass and the common bottle or green glass. A very good sort of which may be thus prepared:

No. 1. *Composition of the best phial-glass.*] "Take of white sand one hundred and twenty pounds, of unpurified pearl-ashes fifty pounds, of common salt ten pounds, of arsenic five pounds, and of magnesia five ounces."——This will be a very good glass for the purpose; and will work with a moderate heat: but requires time to become clear, on account of the proportion of arsenic: when, however, it is once in good condition, it will become very near to the crystal-glass.

No. 2. *Cheapest composition of green or common phial-glass.*] "Take of the cheapest kind of white sand one hundred and twenty pounds, of wood-ashes well

burned and ſifted eighteen pounds, of pearl-aſhes twenty pounds, of common ſalt fifteen pounds, of arſenic one pound." ——This will be green, but tolerably tranſparent; and will work with a moderate fire, and vitrify quickly with a ſtrong one.

*Of the commixture of the ingredients for the ſeveral compoſitions of white tranſparent glaſs.*] The commixture of the ingredients for making glaſs muſt be performed by different methods, according to the nature of the ingredients that enter into the different compoſitions.

When ſand, and fixed alkaline ſalts, whether in form of pearl-aſhes, or of ſuch as are extracted from them, or any other aſhes of vegetables, are uſed together, they ought to be thoroughly mixed, by grinding them in a place free from damp. When they are ſo mixed, they ſhould be put into a proper calcining furnace, and there continued in a moderate heat for five or ſix hours; being in the mean time frequently turned over and ſtirred about, by means of a proper rake; and at the end of that time taken out of the furnace, and either immediately uſed, or kept, where no moiſture can have acceſs to them, till wanted. The matter in this ſtate is called frit, and may be converted into glaſs without further preparation, than being broken into groſs powder before it be put into the pots; unleſs where other ingredients are to be added to it: in which caſe the following methods may be purſued.

When nitre is to be added to the frit, it ſhould be after the calcination: and if it be well powdered, it may be mixed with the frit, without their being ground together.

If arſenic be alſo uſed, it ſhould, being previouſly well levigated, be mixed with the nitre, at the time that it is to be powdered; and they may be then added together to the frit. But if no nitre be uſed, it ſhould be ground with ſome pounds of the frit; or rather with ſome of the ſalts of which the frit is made; and then put to it.

In the case of the flint-glass, when large proportions of lead and nitre are admitted into the composition; or in other cases of soft glass, where very powerful fluxes are used; the calcining the frit is dispensed with, and the sand, alkaline salts, lead, nitre, and also arsenic, if any be used, are thoroughly mixed together by grinding. But if a calcined frit be used, the matter, after it has undergone that operation, and been grossly powdered, must be put into the pot with the other ingredients in that state; they being previously well commixt together by grinding.

If borax be used with the frit alone, it should be ground with a small part of it; and then mixed with the rest. But, if other ingredients are to be added, it may be ground with them. It should, however, be always first calcined, that is, placed in a moderate heat, till the ebullition it makes at first be over, and it be left in a dry state.

When common salt is used in the composition of glass where the frit is prepared, it may be added to the alkaline salt and sand when they are to be ground together; and calcined along with them, which will spare the trouble of the decrepitation, mentioned p. 146 to be necessary. The salt must otherwise be put into a proper vessel, and continued in a gentle heat till it ceases the crackling it will for some time make: and, if it be not used immediately, it must be carefully kept from all moisture, even that of the air. When no frit is previously made, so as to afford an opportunity of calcining the salt with it, being first decrepitated, it may be mixed with any of the other ingredients; but must not be suffered to attract any moisture; otherwise it will crackle and decrepitate again in the pots, and waste the matter, by dissipating it with the numberless little explosions it will make.

Magnesia, when admitted into the composition of glass made of frit without any other addition, being well levigated preparatorily, should be intimately mixed by grinding with some pounds of the frit; and then put into the pots along with the rest. But where lead,

salt petre, or other ingredients are to be added, it may be mixed with them when they are ground; and then put to the frit. If no frit be prepared, it may, nevertheless, be mingled with any of the fluxing ingredients, and so commixt with the whole mass.

*Of the manner of melting and fusing the several compositions, in order to their conversion into glass: with the means of judging when the vitrification is perfect.*] The materials being all prepared and duly mixed, the matter must be put into the pots: and urged to fusion, by a heat proportioned to the strength of the flux in the composition: and this must be continued till the whole mass become one uniform fluid; and have acquired the qualities necessary in that particular kind of glass which is intended to be produced. There is an attention to another object, however, required in the mean time; which is, the taking off the scum and foulness that will arise on the glass in the action of the ingredients on each other, and the coction of the matter. This is to be done by means of proper ladles; and should be effectually performed before the glass be wrought: otherwise it will be so fouled by this substance, as to be rendered of very little value. This matter is called sandever: and is sold to the colourmen, who dispose of it to the potters; and they use it in the compositions of their glazings.

The exact time for keeping the several compositions of glass in fusion, in order to their perfect vitrification, can by no means be settled by rule. For there is so much variation in the disposition of different parcels of materials of the same kind to vitrify; and likewise so great an uncertainty, with respect to the degrees of heat maintainable even in the same furnace, that it must be left to the judgment of the operator. But where the power of the flux is weaker, as may be gathered from the nature and proportions of the ingredients in the composition, or where the heat is less intense, a greater time will necessarily be required, than in the case of stronger fluxes, and brisker fires. No damage can, however, accrue from allowing a longer fusion than may

be necessary to give the glass the appearance of being perfect, except the loss of time and consumption of fuel: for with respect to the white transparent glass, it is always improved in its hardness and clearness, by a longer coction.

In order to examine, whether the glass have attained to its due state of vitrification, an iron rod, of which the end should be bright, or at least entirely free from rust, must be dipped in the melted matter: and what adheres to it should be first tried, with respect to its ductility or readiness to suffer itself to be drawn out in long threads; and, if this quality be found in it to a sufficient degree, being suffered to cool, it should be carefully inspected, to form a judgment of its colour and clearness. If it be transparent, colourless, and free from all specks and bubbles, it may be concluded perfect, and fit to be wrought. But if it want these marks, more time must be given, according to the degree of the defectiveness; and, after a reasonable allowance of such time, it must be examined again by the same means: and, if not yet perfect, a further time must be given, and then the same trial made again. If, nevertheless, after all reasonable allowance of time, and the application of a strong heat, which should be raised as high as can be admitted conveniently, without detriment to the other operations that may be carrying on in the same furnace, the glass yet appear faulty, the means, below advised, must be called in aid; in order to remedy the defects, either in the materials themselves, or the means of their composition.

*Of the means of promoting and accelerating the perfect vitrification of the ingredients, when the composition proves defective in that point: with the means of removing any yellowish or greenish tinge that may arise.*] If, after the treatment above advised, sufficient time and heat having been given, according to the nature of the composition, the glass will not be brought to run into one equal fluid mass, but appear yet turbid and milky, or to abound in bubbles after some abatement of the fire, it must be concluded, that the flux is too weak. An

additional quantity of the fluxing ingredients, mixed together in the same relative proportion as at first, must be therefore put into the pot to the melted mass; but gradually, lest any sudden ebullition may swell the matter, and force part of it out of the pot. The proportion of the whole of this additional quantity, must be regulated by the appearance of what may be wanted from the backwardness of the vitrification in the glass. But it is better to try a smaller quantity first; because more may easily be added, if found necessary; and an excess, on the other hand, injures the qualities of the glass; and in the case of salts cannot be rectified, unless by a long continuance of the fusion. There is, moreover, this further reason for trying only a smaller quantity at first; that frequently much less will answer the end, than the appearance may seem to make necessary.

It is the practice of some, when the vitrification will not go forwards, to have recourse to the following expedient. They take four, or perhaps six ounces of arsenic, and mix with it an ounce of magnesia: and, wrapping them tightly in a piece of paper of several doubles, they fasten the mass to the end of their iron, and plunge it down to the bottom of the pot; where, the substance of the paper being destroyed, the matter is left. This will frequently succeed; and the glass will grow clear first, towards the bottom, and soon after quite to the top; and gain the perfect state of vitrification. The magnesia, nevertheless, however it may promote the fusing power of the arsenic, does not seem a very proper ingredient in all cases. For where there is no yellow tinge in the glass, it will necessarily impart a purplish cast; which, though perhaps in too slight a degree to be easily distinguished on a common inspection, is nevertheless an imperfection; and would show itself if the glass were to be compared with such as were absolutely colourless. I should think it, therefore, better to join two or three ounces of calcined borax with the arsenic, which would answer the end without any kind of injury to the glass, and would not greatly enhance the expence; when it is premised, how con-

siderable a return a pot of glass makes when worked off.

When the glass appears perfect in other respects, but is found to have a green or yellow tinge, such tinge may frequently be diminished by the addition of one or two pounds of nitre; if none, or but a small proportion, have before been admitted into the composition. The nitre, in this case, should be fluxed with some frit, or with some other glass of the same kind with that in the pot, before it be put to the other ingredients. This is requisite, in order that it may the readier mix with the matter; and not be partly blown out of the pot, by the ebullition it would make, in consequence of the water contained in its crystals, or partly swim on the surface; as would happen, if it were put in crude, without being preparatorily heated or mixed with any other body. But if this fail, or remedy only in part the fault, recourse must be had to the magnesia; to which may be advantageously added two or three ounces of arsenic; and they may be conveyed into the pot by the means above directed; which prevents the powders from floating on the surface of the melted matter, where the arsenic would soon sublime away, and take no effect.

*Of the composition and treatment of the common bottle, or green glass.*] This kind, excepting the beauty of colour and transparency, is the most perfect glass at present manufactured; and, with respect to its utility, is also equal in importance to any other. It is formed of sand of any kind, fluxed by the ashes of burned wood, or of any parts of vegetables. The ashes must not have the salts extracted from them, but must consist of them, and the calcined earth of the vegetable substances, whence they are produced. This earth, though when once separated from the salts formed along with it in the incineration, it becomes absolutely refractory to vitrification; and resists not only the same salts which were taken from it, but even the strongest fluxes; yet conjoined with these salts, in the manner in which it is originally produced in the incineration, it not only vitrifies perfectly itself, but even acts as a flux on sand,

For on the mixing ſand with the entire aſhes, a much greater proportion will be converted into glaſs, than would be by the proportion of ſalts contained in the aſhes, if uſed alone without the earth. In general, the bottle-glaſs is only compounded of theſe two ingredients, ſand and wood-aſhes: but where the ſcoria or clinkers of furnaces or forges can be obtained in ſufficient quantity, they may be added with great advantage: as a much leſs proportion of wood-aſhes will become neceſſary, and the good qualities of the glaſs be rather improved than impaired The ſcoria to be obtained at large foundaries, are very proper for the purpoſe: or thoſe from any other ſuch works, where large and ſtrong fires are uſed. The particular compoſition of this glaſs may be as follows; but the proportions here given ſuppoſe the ſofteſt ſand: to procure which care ſhould be taken, as a great ſaving is thence made in the quantity of wood-aſhes neceſſary.

*Compoſition of green or bottle-glaſs.*] "Take of wood-aſhes two hundred pounds, and of ſand one hundred pounds. Mix them thoroughly well by grinding together."—This is the due proportion where the ſand is good, and the wood-aſhes are uſed without any other addition: but there are inſtances of ſand of ſo kindly a nature for vitrification, that a greater proportion of it may be added.

*Compoſition of green or bottle-glaſs, with the addition of ſcoria or clinkers.*] "Take of wood-aſhes one hundred and ſeventy pounds, of ſand one hundred pounds, and of ſcoria or clinkers fifty pounds. Mix the whole well by grinding them together."—The clinkers ſhould be well ground before they be uſed, if they admit of it. But frequently they are too hard; and in that caſe they ſhould be broken into as ſmall bits as can be done conveniently; and mixed with the other matter without any grinding. The harder they are, the leſs material will be the powdering them, as they will the ſooner melt of themſelves in the furnace; and, conſequently, mix with the other ingredients.

The general manner of fuſing, and converting this

compoſition to glaſs, is the ſame as in the other kinds: as are alſo the means of judging when the vitrification is perfect; and the remedy of the defect when the firſt compoſition will not produce it; except with reſpect to colour, which is, in the caſe of this kind of glaſs, entirely out of queſtion. When clinkers are not to be had in ſufficient quantity, to allow of their being uſed in the general compoſition, it is well however to have ſome quantity, to employ occaſionally, when the vitrification fails. For the adding ſuch a proportion of them as may appear neceſſary, with an equal part of wood-aſhes, will anſwer the purpoſe much better, than the addition of more wood-aſhes alone, where the flux is found too weak; as will happen ſometimes from the great variation in the different parcels, as well of the aſhes as ſand.

*Of the general nature of coloured glaſs: and of the ſeveral compoſitions proper for receiving the colours, in order to the forming glaſs, or paſtes, in imitation of precious ſtones; with the qualities attendant on each.*] The glaſs, which is intentionally tinged with colours, may be divided into three kinds: the white opake and ſemi-tranſparent glaſs: the tranſparent coloured glaſs: and the ſemi-tranſparent or opake coloured glaſs.

The white opake glaſs, as alſo ſome tranſparent kinds, are principally uſed for making ſmall vaſes, toys, and ſome ſorts of uſeful veſſels, as cream-pots, &c. in imitation of China-ware of any kind, of which we ſhall ſpeak below. It is alſo frequently employed, as a white enamel for grounds, by painters of enamel dial-plates, ſnuff-boxes, and other ſuch pieces, as have not occaſion to paſs ſeveral times through the fire, in order to their being finiſhed.

The compoſition of white opake and ſemi tranſparent glaſs is very various; as any kind of coloured glaſs may be made the body of ſuch; and the tinge may be given by calcined tin or antimony; alſo by arſenic, calcined hartſhorn or bones, and ſeveral other ſubſtances.

The tranſparent glaſs, tinged with colours, is like-e of different kinds, as the body or ground may be

tranſparent colourleſs glaſs, or any of the compoſitions above exhibited. But it is commonly diſtinguiſhed into two ſorts only; the one called coloured glaſs, and the other paſtes. The reaſon of which diſtinction lies in this. The chief deſign of all coloured tranſparent glaſs being the imitation of precious ſtones, the qualities of ſuch glaſs, when perfect, are to be very clear and tranſparent; to be free from all colour but the proper tinge; and to be very hard and tenacious in their texture. But theſe qualities being not to be had, except in glaſs that is very difficult to be melted, and requires a long as well as an intenſe heat, both to its own mature vitrification, and that of the bodies added to give the colour to it; it became inconvenient to thoſe who prepared theſe kind of compoſitions in ſmall quantities, to maintain ſuch ſtrong fires; and therefore ſofter compoſitions were ſought for, that would run with the heat of common ſmall furnaces; and would likewiſe be brought to perfection in a much ſhorter time. Theſe compoſitions were therefore called paſtes, to diſtinguiſh them from the harder glaſs, which retained its proper appellation.

The glaſs moſt proper for the imitation of precious ſtones, where the hardneſs, which is a moſt valuable quality in ſuch as is intended for mock jewels, that are expoſed to much wear, is wanted, is a perfect glaſs of ſalts; in which no more flux is admitted, than merely what may be neceſſary for the complete vitrification of the glaſs, and tinging ſubſtances; but it ſhould be abſolutely free from every kind of tinge, except that which is intended to be given it.

The kind moſt proper for forming paſtes, is a mixed glaſs of lead and ſalts, which will run eaſily; and vitrify in a ſhort time the metalline or other bodies that are employed for tinging it. But in order to make it yet more fuſible, without having ſo large a proportion of lead as may make the texture of the glaſs too tender and brittle, arſenic and borax may be admitted into the compoſition. Beſides the forming imitations of coloured

ſtones, there is yet another purpoſe to which this kind of glaſs is peculiarly adapted, which is the making mock diamonds and topazes, that cannot be ſo well counterfeited by any other compoſition; as the lead, according to what was before obſerved, gives a very extraordinary refracting power to the glaſs, of which it is an ingredient. This ſort might ſeem to belong to the claſs of the white tranſparent kinds of glaſs before treated of: but as the application of that kind of compoſition, which renders it properly a paſte according to the above diſtinction, is confined to the intentions of imitating gems, it is more properly introduced amongſt the others, with which it has a common denomination.

The ſemi tranſparent coloured glaſs may have for its body, either the compoſitions of the harder kinds; or thoſe of paſtes: and it is principally applied to the imitation of the ſemi-tranſparent ſtones, as lapis lazuli, chalcedony, jaſper, agate, opal, or ſuch others. The manner of compoſing them is much the ſame, as that of the tranſparent kinds; except the adding ſome opake white body, which will endure the fuſion of the glaſs, without being vitrified, at leaſt long enough to ſuffer it to be worked into the proper form. But the management of thoſe of this kind, which are compounded of a variety of colours, is much more difficult than that of the tranſparent ſorts: which is moſt probably the reaſon why they are ſo little in uſe; though ſome of them have a very beautiful effect for purpoſes they might be equally well applied to with the genuine ſtones.

*Of the nature and preparation of the ſubſtances uſed for tinging glaſs.*] The ſubſtances employed for tinging glaſs, are, for the moſt part, metallic and other foſſible bodies; or indeed all are ſo, except tartar, which has been added to ſome compoſitions. The metals themſelves make the principal part; and, properly treated, will produce all the colours, except a perfect blue. But for cheapneſs and expedience, the ſemi-metals, and preparations from other foſſible bodies, are ſometimes admitted into the place of them; particularly with re-

ſpect to yellow, where antimony ſupplies the place of ſilver.

The ſubſtances that have been uſed for producing any opake whiteneſs in glaſs, are calcined tin, (commonly called putty) calcined antimony, arſenic, calcined horns or bones, and ſometimes common ſalt. The ſubſtances employed for red, are gold, iron, copper, magneſia and antimony. The ſubſtances employed for blue, are zaffer and copper. The ſubſtances that have been employed for yellow, are ſilver, iron, antimony and magneſia, with tartar. The ſubſtances employed for greens, are copper, Bohemian granate, and thoſe which will produce yellow or blue. The ſubſtances employed for purple, are all ſuch as will produce red and blue. The ſubſtances employed for orange colour, are antimony, and all thoſe which will produce red and yellow. The ſubſtances employed for black, are zaffer, magneſia, copper and iron, in various combinations. The Bohemian granate requires no other preparation than to be well pulverized.

*Compoſition of hard glaſs and paſtes, proper for receiving colours.*] Though almoſt every kind of tranſparent colourleſs glaſs will admit of being tinged; yet there are, as was obſerved before, ſome compoſitions, that are more peculiarly adapted to the purpoſes for which the coloured glaſs is intended, either by their hardneſs and tenacious texture; or their being more eaſy to be wrought by thoſe who manufacture them, from their requiring leſs heat to fuſe them, and fluxing the colorific matter expeditiouſly. The clearneſs and tranſparency of the glaſs, and the being devoid of any colour but that intended to be given, are likewiſe neceſſary in both the hard glaſs and paſtes which are to be coloured: and therefore to have them in perfection, a glaſs of each kind ſhould be purpoſely prepared; in which more exact methods may be uſed for producing theſe qualities, than are expediently compatible with the diſpatch and profit of groſſer manufactures. The beſt compoſitions for the hard glaſs are as follows: but as the extreme purity of the fixed alkaline ſalts is of very

great conſequence in this caſe, it may not be improper to give previouſly the method of producing it.

*Method of bringing pearl-aſhes, or any other fixed alkaline ſalts of vegetables, to the higheſt degree of purity, proper for the moſt tranſparent glaſs.*] "Take of the beſt pearl-aſhes three pounds, and of ſalt-petre ſix ounces. Pound them together in a glaſs or marble mortar, till they are thoroughly well mixed; and then put part of them into a large crucible, and ſet it in a furnace, where it may undergo a ſtrong heat. When the part of the matter, that was firſt put into the crucible, is heated red hot, throw in the reſt gradually: and if the crucible will not contain the whole, pour part of the melted matter out on a moiſtened ſtone, or marble; and, having made room in the crucible, put in the reſt; and let it continue there, likewiſe, till it be red hot. Pour it out then as the other; and afterwards put the whole into an earthen, or very clean iron pot, with ten pints of water; and heat it over the fire, till the ſalts be entirely melted. Let it then, being taken off the fire, ſtand till it be cold; and afterwards filter it through paper, in a pewter cullender. When it is filtered, return the fluid again into the pot, and evaporate the ſalt to dryneſs, which will then be as white as ſnow; the nitre having burnt all the phlogiſtic matter that remained in the pearl-aſhes after their former calcination.

No. 1. *Compoſition of the beſt and hardeſt glaſs for receiving colours.*] "Take of the beſt ſand, cleanſed by waſhing as directed in p. 147, twelve pounds, of pearl-aſhes, or fixed alkaline ſalt purified with nitre as above, ſeven pounds, of ſalt-petre one pound, and of borax half a pound."—The ſand being firſt reduced to powder in a glaſs or flint mortar, the other ingredients ſhould be put to it, and the whole well mixed, by pounding them together.

No. 2. *Compoſition of the beſt glaſs for receiving colours; but ſomewhat leſs hard than the above.*] "Take of white ſand cleanſed twelve pounds, of pearl-aſhes purified with ſalt-petre ſeven pounds, of nitre one pound, of borax half a pound, and of arſenic four ounces."—

Proceed as in the laſt; but if the glaſs be deſired to melt with yet leſs heat, a pound of borax may be uſed inſtead of the half pound, and a pound of common ſalt may be added; but this laſt is apt to make the glaſs more brittle; which is an injury done to ſuch as is to be cut into very ſmall pieces, and ground with ſo many angles in the figure, as in the imitations of jewels.

No. 3. *Compoſition of ſoft glaſs or paſte, proper for receiving colours.*] "Take of white ſand cleanſed ſix pounds, of red-lead three pounds, of purified pearl-aſhes two pounds, and of nitre one pound."—Proceed in the mixture as with the foregoing.

No. 4. *Compoſition of glaſs, or paſte, much ſofter than the above.*] "Take of white ſand cleanſed ſix pounds, of red lead and purified pearl-aſhes, each three pounds, of nitre one pound, of borax half a pound, and of arſenic three ounces."—To be mixed as all the preceding. This is very ſoft, and will fuſe with a very gentle heat, but requires ſome time to become clear, on account of the arſenic. It may even be prepared and tinged in a common fire without a furnace; if the pots containing it can be ſurrounded by burning coals, without danger of their falling into it. The borax, being a more expenſive ingredient than the others, may be omitted, where a ſomewhat greater heat can be applied; and the glaſs is not intended for very nice purpoſes. Or a pound of common ſalt may be ſubſtituted in its place. But the glaſs will be more clear and perfect; and free itſelf much ſooner from bubbles, where the borax is uſed. This glaſs will be very ſoft, and will not bear much wear, if employed for rings, buckles, or ſuch imitations of ſtones, as are expoſed to much rubbing. But for ear-rings, ornaments worn on the breaſt, or ſuch others as are but ſeldom put on, it may laſt a conſiderable time. In all theſe ſoft compoſitions, care ſhould be taken, that part of the ſand be not left unvitrified in the bottom of the pot; as will ſometimes happen. For, in that caſe, the glaſs, abounding too much with ſalts and lead, will not bear the air; but being corroded by it, will ſoon contract a miſtineſs, and

ſpecks on the ſurface; which will entirely efface all the luſtre of the paſte. An unlucky inſtance of this particularly happened a few years ago, to the great loſs, and almoſt ruin of many of the poorer lapidaries. For there being at that time a great demand for all kinds of ornaments decorated with falſe ſtones for the Spaniſh Weſt-Indian trade, a perſon undertook to make them and furniſh the lapidaries; who, glad of an opportunity of obtaining, on moderate terms, what they had found it difficult to procure before, (as the coloured glaſs had for the moſt part been imported from Venice) purchaſed as large quantities as they poſſibly could find money to pay for. But in a ſhort time, both the unwrought paſte, and that which they had been at the labour and expence of cutting, all turned foul, with a dull ſcum on the ſurface and little ſpecks, which eat down into the ſubſtance; and took away the ſmoothneſs, as well as the luſtre. It is proper, therefore, for thoſe, who prepare ſuch compoſitions, to be careful of adding more ſalts and lead than the proportions here given; and to watch that the ſand, or other matter employed for the body of the compoſition, be really fluxed. And it is equally proper, that they who purchaſe ſuch paſte, ſhould have ſome good ground of aſſurance of its being duly prepared; otherwiſe, they may throw away their money in the purchaſe, their time in cutting, and their credit in diſpoſing, of ſuch a faulty commodity. There is a very certain and good method of preventing the inconvenience ariſing from the ſeparation of the ſalts in the preparation, as well of the hard kind of coloured glaſs, as the paſtes; which is, by previouſly calcining the ſand, and fixed alkaline ſalts, as in the manner of making the frit. This may be done, by putting the ſand and ſalt, reduced to powder and mixed together, on a tile placed in a furnace of moderate heat; and turning over and ſtirring the matter with a tobacco-pipe, or ſmall iron rod; for which purpoſe, the tile ſhould be either placed near ſome proper opening into the furnace, or drawn to the door at due intervals. When the matter appears to coaleſce ſtrongly, and form a hard body on cooling, it may be taken out; and being kept entirely free from

moiſture, ſhould be powdered. It ſhould be then added to the other materials according to the proportion that would have been obſerved, with regard to the ingredients of the frit, if they had been uſed without being combined previouſly, by means of this operation.

*Compoſitions of glaſs, or paſte, of a red colour.*

No. 1. *Compoſition of a fine red glaſs reſembling the ruby.*] "Take of the hard glaſs, No. 1. or No. 2. one pound, of the calx caſſii, or gold prepared by precipitation, with tin 3 drachms. Powder the glaſs; and grind the calx of gold afterwards with it in a glaſs, flint, or agate mortar; and then fuſe them together." ——This may be made of a ſtronger or more diluted colour, by varying the proportion of the gold: in adjuſting which properly, regard ſhould be had to the application of the glaſs, when made. For where this glaſs is ſet in rings, bracelets, or other cloſe work, where foils can be uſed, a great ſaving may be made, with regard to the colour of it, without much injury to the effect. But for ear-rings, or other purpoſes, where the work is ſet tranſparent, a full ſtrong colour ſhould be given: which may be effected by the proportions directed in this compoſition.

No. 2. *Compoſition of a paſte reſembling the ruby.*] "Take of the paſte, No. 3. or No 4. one pound, of calx caſſii, or precipitation of gold by tin, two drachms. Proceed in the mixture as with the above."——This will be equally beautiful with the above; and defective only in ſoftneſs. But as that greatly takes away the value for ſome purpoſes, ſuch as is appropriated to them may be tinged in a cheaper manner by the following means.

No. 3. *Compoſition of a cheaper paſte reſembling the ruby.*] "Take of the compoſition for paſte, No. 3. or No. 4. half a pound, of glaſs of antimony half a pound, and of the precipitation of gold by tin one drachm and half. Proceed as with the others."—This will be conſiderably cheaper; and will have much the ſame effect, except that it recedes more from the crimſon to the orange.

No. 4. *Compoſition for hard glaſs reſembling the garnet.*] "Take of the compoſitions for hard glaſs, No. 1. or No. 2. two pounds, of glaſs of antimony one pound, of magneſia, and of the precipitate of gold by tin, each one drachm."—This compoſition is very beautiful, but too expenſive, on account of the gold, for the imitation of garnets for common purpoſes, on which account the following may be ſubſtituted.

No. 5. *Cheaper compoſition of hard glaſs reſembling the garnet.*] "Take of the compoſitions, No. 1. or No. 2. two pounds, of the glaſs of antimony two pounds, and of magneſia, two drachms."——If the colour be found too dark and purple in either this and the preceding compoſition, the proportion of magneſia muſt be diminiſhed.

No. 6. *Compoſition of paſte of the colour of garnet.*] "Take of the compoſitions for paſtes, No. 1. or No. 2. and proceed as with the above."

No. 7. *Compoſition of hard glaſs reſembling the vinegar garnet.*] "Take of the compoſitions No. 1. or No. 2. two pounds, of glaſs of antimony one pound, of iron highly calcined half an ounce. Mix the iron with the uncoloured glaſs, and fuſe them together, till the maſs be perfectly tranſparent; then add the glaſs of antimony powdered, ſtirring the mixture with the end of a tobacco-pipe; and continue them in the heat, till the whole be perfectly incorporated."

No. 8. *Compoſition of paſte reſembling the vinegar garnet.*] "Take of the compoſition for paſte, No. 3. or No. 4, and proceed as with the foregoing."—In this, as well as in all the ſucceeding compoſitions, it ſhould be obſerved, that ſome allowance may be made in the proportion of the colorific, or tinging matter, for the greater variety of the paſtes than the hard glaſs, on the ſcore of the lead which enters into the compoſition. For, as the volume, in a pound weight of the paſte, is, conſequently, leſs; a leſs quantity of tinging matter is proportionably neceſſary to give the ſame force of colour to it.

*Compositions of glass and paste, of a blue colour.*

No. 1. *Composition of hard glass of a very full blue colour.*] "Take of the composition for hard glass, No. 1. or No. 2. ten pounds, of zaffer six drachms, and of magnesia two drachms. Proceed as with the above."—If this glass be of too deep a colour, the proportions of the zaffer and magnesia to the glass may be diminished: and if it verge too much on the purple, to which cast it will incline, the magnesia should be omitted. If a very cool or pure blue be wanted, instead of the magnesia, half an ounce of calcined copper may be used; and the proportion of zaffer diminished by one half.

No. 2. *Composition of paste of a full blue colour.*] "Take of the composition for paste, No. 1. or No. 2. ten pounds, and proceed as with the foregoing."

No. 3. *Composition of hard glass resembling the sapphire.*] "Take of the compositions for hard glass, No. 1 or No. 2. ten pounds, of zaffer three drachms and one scruple, of the calx cassii, or precipitation of gold by tin, one drachm. Proceed as with the above."

No. 4. *Cheaper composition of hard glass resembling the sapphire.*] "As the foregoing; only, instead of the precipitate of gold, use two drachms and two scruples of magnesia."—If this be well managed, the colour will be very good; and the glass, when set and cut, will not be easily distinguishable from the true sapphire: but the preceding will be a fine colour, as there is a foulness in the tinge of the magnesia, which will always diminish, in some degree, the effect of brighter colours, when mixed with them.

No. 5. *Composition of paste resembling the sapphire.*] "Take of the composition for paste, No. 3. or No. 4. and proceed as with the foregoing."—It is not worth while to bestow the expence of colouring pastes with the gold: and it is, therefore, more expedient, in the case of such, to use the other method.

No. 6. *Composition of hard glass and pastes, resembling sapphires, by means of smalt.*] "Take of the compositions for hard glass and pastes, any quantity; and

mix with them one-eighth of their weight of smalt, the brighteſt and moſt inclining to purple, that can be procured."——If it be deſired to give a more purple tinge, magneſia may be added in the proportion required.

No. 7. *Compoſition of hard glaſs reſembling the eagle marine (vulgarly called egg-marine.*] "Take of the compoſition for hard glaſs, No. 1. or No. 2. ten pounds, of copper highly calcined with ſulphur three ounces, and of zaffer one ſcruple. Proceed as with the foregoing."

No. 8. *Compoſition of paſte reſembling the eagle marine.*] "Take of the compoſition for paſte, No. 1. or No. 2. ten pounds; and proceed as with the above."

*Compoſitions of hard glaſs, and paſtes, of a yellow colour.*

No. 1. *Compoſition of hard glaſs of gold, or full yellow colour.*] "Take of the compoſitions for hard glaſs, No. 1. or No. 2. ten pounds, but omit the ſalt-petre; and for every pound add an ounce of calcined borax; or, if that do not render the glaſs ſufficiently fuſible, two ounces, of red tartar, the deepeſt coloured that can be procured, ten ounces; of magneſia two ounces; of charcoal of ſallow, or any other ſoft kind, two drachms. Proceed as with the reſt."——This colour may be prepared with ſilver: but as there is no advantage in that to counterbalance the expence, I wave giving the proceſs.

No. 2. *Compoſition of paſte of a gold or full yellow colour.*] "Take of the compoſition for paſte, No. 3. or No. 4. prepared without the ſalt petre, ten pounds; of iron ſtrongly calcined, one ounce and a half. Proceed as with the others."—The crude tartar and the charcoal muſt not be uſed, where lead enters into the compoſition of the glaſs; and the nitre may be ſpared; becauſe the yellow tinge given to the glaſs by the lead, on account of which the nitre is uſed, is no detriment in this caſe; but only adds to the proper colour. This colour may alſo be prepared by crude antimony, as well as the calcined iron: but it is more difficult to be managed, and not ſuperior in its effect.

No. 3. *Compoſition of hard glaſs reſembling the topaz.*] "Take of the compoſition for hard glaſs, No. 1. or No. 2. ten pounds, and an equal quantity of the gold coloured hard glaſs. Powder, and fuſe them together."—As there is a great variety in the colour of the topaz, ſome being a deeper yellow, and others ſlightly tinged, the proportions of the yellow glaſs to the white, may be accordingly varied at pleaſure: that here given being for the deepeſt.

No. 4. *Compoſition of paſte reſembling the topaz.*] "This may be done in the ſame manner as the preceding: but the ſalt-petre may be omitted in the original compoſition of the glaſs: and for the reſemblance of the very ſlightly coloured topazes, neither the gold coloured paſte, nor any other tinging matter need be added, that of the lead being ſufficient, when not deſtroyed by the nitre."

No. 5. *Compoſition of hard glaſs reſembling the cryſolite.*] "Take of the compoſition for hard glaſs, No. 1. or No. 2. ten pounds, of calcined iron ſix drachms. Proceed as with the above."

No. 6. *Compoſition of paſte reſembling the cryſolite.*] "Take of the compoſition for paſte, No. 3. or No. 4. prepared without ſalt-petre, ten pounds, and of calcined iron five drachms. Proceed as with the reſt."

*Compoſition of hard glaſs, and paſte, of a green colour.*

No. 1. *Compoſition of hard glaſs reſembling the emerald.*] "Take of the compoſition for hard glaſs, No. 1. or No. 2. nine pounds, of copper, precipitated from aquafortis, three ounces, and of precipitated iron two drachms."

No. 2. *Compoſition of paſte reſembling the emerald.*] "Take of the compoſition for paſte, No. 1. or No. 2. and proceed as with the above: but if the ſalt-petre be omitted in the preparation of the paſte, a leſs proportion of the iron will ſerve."

*Compoſitions of glaſs and paſtes, of a purple colour.*

No. 1. *Compoſition of hard glaſs, of a deep and very bright purple colour.*] "Take of the compoſition for hard glaſs, No. 1. or No. 2. ten pounds, of zaffer ſix

drachms, of gold precipitated by tin one drachm. Proceed as with the reſt."

No. 2. *Cheaper compoſition of hard glaſs of a deep purple colour.*] "Take of the compoſitions for hard glaſs, No. 1. or No. 2. ten pounds, of magneſia one ounce, and of zaffer half an ounce. Proceed as with the others."

No. 3. *Compoſition of paſte of a deep purple colour.*] "Take of the compoſitions for paſtes, No. 3. or No. 4. ten pounds; and treat them as the foregoing."

No. 4. *Compoſition of hard glaſs of the colour of the amethyſt.*] "Take of the compoſition for hard glaſs, No. 1. or No. 2. ten pounds, of magneſia one ounce and a half; and of zaffer one drachm. Proceed as with the reſt."

No. 5. *Compoſition of paſte of the colour of the amethyſt.*] "Take of the compoſition for paſte, No. 1. or No. 2. ten pounds; and treat it as the preceding."

*Of paſte reſembling the diamond.*] "Take of the white ſand ſix pounds, of red-lead four pounds, of pearl-aſhes, purified as above directed, three pounds, of nitre two pounds, of arſenic five ounces, and of magneſia one ſcruple. Proceed as with the others: but continue the fuſion for a conſiderable time, on account of the large proportion of arſenic."—If this compoſition be thoroughly vitrified, and kept free from bubbles, it will be very white, and have a very great luſtre; but, if on examination it yet appear to incline to yellow, another ſcruple or more of the magneſia may be added. It may be rendered harder, by diminiſhing the proportion of lead, and increaſing that of the ſalts; or fuſing it with a very ſtrong fire: but the diminution of the proportion of lead will make it have leſs of the luſtre of the diamonds.

*Compoſition of hard glaſs perfectly black.*]—"Take of the compoſition for hard glaſs, No. 1. or No. 2. ten pounds, of zaffer one ounce, of magneſia, and of iron ſtrongly calcined, each ſix drachms. Proceed as with the reſt."

*Compoſition of paſte perfectly black.*] "Take of the

compoſition for paſte, No. 1. or No. 2. prepared with the ſalt petre, ten pounds, of zaffer one ounce, of magneſia ſix drachms, and of iron highly calcined five drachms. Proceed as with the others."

*Of the white opake, and ſemi-tranſparent glaſs, and paſtes.*

No. 1. *Compoſition of white opake glaſs.*] "Take of the compoſition for hard glaſs, No. 1. or No. 2. ten pounds, of horn, ivory or bone, calcined perfectly white, one pound. Proceed as with the others."

No. 2. *Compoſition of paſte of an opake whiteneſs.*] "Take of the compoſition, No. 3. or No. 4. ten pounds, and make the ſame addition as to the above."

No. 3. *Compoſition of glaſs of an opake whiteneſs formed by arſenic.*] "Take of flint-glaſs ten pounds, and of very white arſenic one pound. Powder and mix them thoroughly, by grinding them together; and then fuſe them with a moderate heat, till they be well incorporated: but avoid liquifying them more, than to make a perfect union."—This glaſs has been made at a conſiderable work near London in great quantities; and has not only been manufactured into a variety of different kinds of veſſels, but, being very white and fuſible with a moderate heat, has been much uſed as a white ground for enamel in dial-plates, ſnuff-boxes, and other pieces, which have not occaſion to go ſeveral times into the fire to be finiſhed. It will not, however, bear repeated burnings, nor a ſtrong heat continued for any length of time, when applied to this purpoſe, without becoming tranſparent; to which likewiſe, the ſmoke of a coal fire will alſo greatly contribute: but it anſwers the end very well in many caſes; though even in thoſe, enamel of the ſame degree of whiteneſs would be preferable; as this is always brittle, and of leſs firm and tenacious texture.

No. 4. *Compoſition of hard glaſs, or paſte, formed by calk of tin or antimony.*] "Take of any of the compoſitions for hard glaſs or paſtes, ten pounds, of calcined tin, (commonly called putty) or of antimony, or tin calcined by means of nitre, one pound and a half. Mix them well, by grinding them together; and then fuſe

them with a moderate heat."—The glass of this kind, made with the composition for pastes, differs in nothing from white enamel, but in the proportion of the calx of tin and antimony: and, if those calxes be prepared with nitre, (without which they cannot be made to produce a pure whiteness in glass) this composition will be more expence and trouble than those above given, without any other advantage, than that it will bear the action of a much stronger and longer continued fire, without losing its opacity in any degree, than the others.

No. 5. *Composition of semi-transparent white glass and paste, resembling the opal.*] "Take of any of the compositions for hard glass, or paste, ten pounds, of horn, bone, or ivory, calcined to a perfect whiteness, half a pound. Proceed as with the rest."—This white hard glass is much the same with the German glass formerly brought here in porringers, cream-pots, vinegar-cruets, and other such pieces, of which we frequently meet with the remains.

*Compositions of fictitious or counterfeit lapis lazuli.*] "Take of any of the above compositions for hard glass, or paste, ten pounds, of calcined bones, horn or ivory, three quarters of a pound, of zaffer one ounce and a half, of magnesia half an ounce. Fuse the uncoloured composition with the zaffer and magnesia, till a very deep transparent blue glass be produced. The mass being cold, powder it: and mix it with the calcined matter, by grinding them together. After which, fuse them with a moderate heat, till they appear to be thoroughly incorporated; and then form the melted mass into cakes, by pouring it on a clean bright plate of copper or iron."——If it be desired to have it veined with gold, it may be done, by mixing the gold powder with an equal weight of calcined borax, and tempering them with oil of spike; by which mixture, the cakes, being painted with such veins as are desired, they must be put into a furnace of a moderate heat; and the gold will be cemented to the glass, as firmly as if the veins had been natural. If the counterfeit lapis lazuli be

desired of a lighter hue, the quantity of zaffer and magnesia must be diminished; or, if it be required to be more transparent, that of the calcined horn, bone, or ivory, should be lessened. Instead of zaffer, where that cannot be obtained, a proper proportion of smalt may be substituted. And in all cases, indeed, it may be a more certain way, to form the zaffer and vitrifying ingredients into glass alone, and then, having powdered them with the calcined bones or horns, infuse them a second time, and make them into cakes in the manner directed. For the fluxing power of the ingredients of the glass is so retarded by the calcined bone or horn, that it may, in some cases, fail to act sufficiently on the zaffer to vitrify it perfectly.

*Composition of hard glass resembling the red cornelian.*] "Take of the compositions for hard glass, No. 1. or No. 2. two pounds, of glass of antimony one pound, of the calcined vitriol, called scarlet oker, two ounces, and of magnesia one drachm. Fuse the glass of antimony and magnesia with the other glass first together; and then powder them well, and mix them with the scarlet oker, by grinding them together; and afterwards fuse the mixture with a gentle heat, till they be incorporated: but the heat must not be continued longer than is absolutely required to form them into a vitreous mass."—If it be desired to have the composition more transparent, a proportionable part of the red oker must be omitted.

*Composition of paste resembling the red cornelian.*] "Take of the compositions for pastes, No. 1. or No. 2. two pounds; and proceed as with the above."

*Composition of hard glass resembling the white cornelian.*] "Take of the compositions for hard glass, No. 1. or No. 2. two pounds, of yellow oker well washed, two drachms, and of calcined bones, each one ounce. Mix them well by grinding them together; and fuse them with a gentle heat, till the several ingredients be well incorporated in a vitreous mass."

*Composition of paste resembling the white cornelian.*]

"Take of the compoſition for paſtes, No. 1. or No. 2. two pounds; and proceed as with the foregoing."

*Compoſition of hard glaſs, or paſte, reſembling the turquoiſe ſtone.*] "Take of the compoſition for blue glaſs, or paſte, No. 7. or 8. (being thoſe reſembling the eagle-marine) ten pounds, of calcined bone, horn, or ivory, half a pound. Powder and mix them well; and then fuſe them in a moderate heat, till they be thoroughly incorporated."——If the colour be not ſo deep as may be deſired, a ſmall proportion of ſmalt may be added.

*Compoſition of the brown Venetian glaſs with gold ſpangles; commonly called the Philoſopher's ſtone.*] "Take of the compoſition for hard glaſs, No. 2. and the compoſition for paſte, No. 1. each five pounds, and of highly calcined iron one ounce. Mix them well, and fuſe them till the iron be perfectly vitrified; and have tinged the glaſs of a deep tranſparent yellow brown colour. Powder this glaſs; and add to it two pounds of glaſs of antimony, being powdered; and mix them well, by grinding them together. Take part of this mixture, and rub into it fourſcore or one hundred leaves of the counterfeit leaf-gold, commonly called Dutch gold; and, when the parts of the gold ſeem ſufficiently divided, mix the powder containing it with the other part of the glaſs. Fuſe the whole then with a moderate heat, till the powder run into a vitreous maſs fit to be wrought into any of the figures, or veſſels, into which it is uſually formed: but avoid a perfect liquefaction; becauſe that deſtroys, in a ſhort time, the equal diffuſion of the ſpangles; and vitrifies, at leaſt part, the matter of which they are compoſed; converting the whole to a kind of tranſparent olive coloured glaſs."——This kind of glaſs is uſed for a great variety of toys and ornaments, and procured from the Venetians. A few years ago a very great demand aroſe for it to China, and raiſed the price very high, till ſuch quantities had been brought from Venice, and ſent thither, as glutted the market. But there is no reaſon why it ſhould not be equally well prepared here; and

at a small expence; as will be found, on a few trials, by those who will carefully execute what is here directed.

*Of the fusion and vitrification of the several compositions of coloured glass; with the particular rules and cautions to be observed in the management of each kind.*] The several compositions above-mentioned being prepared according to the directions respectively given; the matter should be put into proper pots, of which it should not fill above two-thirds; and then placed in the furnace, or in any other kind, where they may receive a sufficient heat, and be secured from any coals, soot, or any other filth, falling into them. In order to prevent which, it is expedient, with regard to the pots in which this kind of glass is prepared, to have covers over the tops of them, with a little return over the side. And it is also proper to have a hole in the side, a little below the return; through which an iron may be passed to take out a small quantity of the melted matter, for the judging of the progress of the vitrification. These pots, when put into the furnace above-mentioned, should be placed on the flooring or stage intended to support them in the part betwixt the doors, opposite to that through which they are passed into the furnace, according to the manner before directed; which should be done by means of a strong iron peel, like those used by the bakers. It is necessary to observe, likewise, that however well the pots may have been before baked, it is always proper, in the case of glass of greater value, where the clearness and beauty is of consequence, to give them another burning before they be used; and, at the same time, to incrust them over with any common colourless glass; which may be done in this manner: Having reduced the glass to powder, moisten all the inside of the pot with water; and, while it is yet moist, put in some of the powdered glass, and shake it about till the whole inner surface of the pot be covered by what will adhere to it, in consequence of the moisture. Throw out then the redundant part of the powdered glass; and, the pot being dry, set it in a furnace sufficiently

hot to vitrify the glaſs adhering to it; and let it continue there ſome time: after which, care muſt be taken to let it cool gradually.

The pots, containing the compoſition, being thus placed in the furnace, a gentle heat, ſuch as will juſt keep the pots red hot, ſhould be given for the firſt hour or longer. There is, however, an exception to this, which is, where there is much arſenic in the compoſition, which requires that ſome degree of vitrification ſhould be brought on as quickly as poſſible, in order to fix it, and prevent its ſubliming away from the other ingredients; which it will not ceaſe to do, ſo long as continued in the ſtate of a powder. But where a gentle heat is proper at firſt, after the expiration of an hour and a half, or two hours at furtheſt, the heat may be raiſed ſufficiently to produce a vitrification; but not ſo as to render the melted matter very fluid at firſt; which in this part of the proceſs would occaſion a ſeparation of the ingredients; and greatly retard, if not intirely prevent, the perfect vitrific incorporation of the whole.

The due degree or continuance of heat, for the perfecting theſe kinds of glaſs, cannot be ſettled by any ſtandard, as they are varied both by the nature of the compoſition, and the quantity of the matter. But in the caſe of pots which hold ten or eleven pounds, twenty or twenty-four hours may be allowed for hard glaſs, and fourteen or ſixteen for paſtes. And where much arſenic enters into the compoſition, though it is neceſſary to bring on a quicker vitrification, yet more time muſt ſometimes be given to the matter, than in other caſes, before all the cloudineſs be diſſipated.

In the fuſion of the tranſparent coloured glaſs, it is above all things neceſſary to avoid ſtirring the matter, or even ſhaking the pots; as it would otherwiſe hazard the cauſing bubbles in the glaſs, to prevent which is the greateſt difficulty attending the preparation of counterfeit gems. But if the ingredients, by their action on each other, do yet, notwithſtanding all exterior conculſion be avoided, produce bubbles, the glaſs muſt be continued in fuſion till they wholly vaniſh. And

if, when bubbles do arise in the glass, and time be given for it, there appear no tendency to their going away, the heat must be gradually raised to a greater pitch, that the glass may be rendered more fluid, and that vicidity, which was the occasion of their detension, removed.

When a proper time has been given the glass to attain to a perfect state of vitrification, it should be examined, by putting the small end of a tobacco-pipe to the surface of the glass, thro' the hole in the side of the pot; which will bring away with it a little quantity of the glass, from whence the qualities may be judged of. And if there appear any defects, that seem owing to the want of a due conversion of the ingredients to a vitrious state, more time and heat must be given to it. But if no such defects are found, and the glass appear perfect, the fire should be decreased, and, by degrees, suffered to go out; and the pots continued in the furnace, till they become cold: after which, the pot should be torn off from the mass of glass contained in it. As, however, it is not always convenient to discontinue the heat of the furnace, when one or more pots of the glass may have attained to the due state of vitrification; they may, on such occasions, be taken out. And if the glass be not of great value, nor intended for very nice purposes, it may be formed into cakes, by pouring it on a clean plate of iron or copper, or into rolls. These cakes, or rolls, should be put into a moderate heat, before they grow cold; and continued there for some time, that they may gain a good temper, so as to bear cutting or working in any way, according to the use they are intended for.

The transparent coloured glass is in most cases improved, by continuing it in the heat, even for a considerable time after the vitrification seems perfected; as it is, by that means, rendered harder, and freer from specks and bubbles. But the semi-transparent kinds, and opake white, formed of arsenic, must be taken just at the point, when the ingredients are duly united; for a more mature vitrification converts to transparent glass

the whole, or part of thoſe ſubſtances, which ſhould not be brought to that ſtate. But as I have before intimated in what particular caſts this requires to be moſt attended to, it is needful to enlarge further on the matter here.

*Of colouring rock cryſtals for the imitation of gems.*] The far greater hardneſs of cryſtal than of any kind of glaſs, and the ſuperior luſtre of it to any but paſtes, which are deplorably ſoft, have rendered the art of imparting to it the colour of gems, an object of frequent and eager purſuit: as great advantages might probably have ariſen from it to the firſt inventors. There are two methods, by which it has been conceived there was a poſſibility of doing it: the one, by cementing; that is, impregnating the cryſtals by means of heat, with the proper tinging particles, under the form of ſteam: the other, by bringing the cryſtal to a ſtate of fuſion, thro' the means of heat aided by a ſtrong flux; and combining it in that ſtate with the proper colouring ſubſtances. Both of theſe have been pretended to be effected in a perfect manner: and very oſtentatious accounts of them have been given to the public: though it is much to be feared, that ſo far from having carried this art to any degree of perfection, there is not hitherto known one ſingle fact, or principle, that in the leaſt ſeems to lead to the attainment of it. As the world has been made to believe, however, as well more lately as formerly, by perſons of ſome authority, that both theſe methods have been practiſed with all the deſired ſucceſs. I will exhibit the particular manner in which each has been practiſed, by thoſe who have been believed to be moſt the maſters of theſe arts.

"Take of very yellow orpiment, and white arſenic, each two ounces, and of antimony and ſal ammoniacum each one ounce; and having reduced them to powder, mix them well together, and put them into a large crucible. Over this mixture, lay the pieces of rock cryſtal; firſt ſuch as are of the leaſt ſize, then larger, and at the top the biggeſt; taking care, that thoſe choſen for this purpoſe have no flaws nor foulneſs. This crucible

muſt then be covered by a leſſer turned upſide down upon it, in the bottom of which, there ſhould be previouſly made a little opening of the bigneſs of a pea; in order that this bottom, becoming now the top of the veſſel, formed by joining the two together, the fumes of the matter contained may have vent through the hole; and, conſequently, being determined upwards, may paſs through the cryſtals, and act upon them. The joints produced by inverting the leſſer crucible into the greater ſhould be luted; and being dry, the veſſel thus formed muſt be put in the midſt of pieces of charcoal, in ſuch manner, that the undermoſt crucible may be buried in them intirely; and the uppermoſt half way. The coals muſt then be kindled, and the fire ſuffered to burn very gradually without blowing, unleſs it ſhould be neceſſary to keep it from extinguiſhing; to prevent which from happening too ſoon, the pieces of charcoal ſhould be choſen large. As the fire riſes, the mixture in the crucible will emit copious fumes: which being very noxious, muſt be carefully avoided: and to that end this operation ſhould be always performed under a chimney; the front of which ſhould be brought ſo low, that all the ſmoke may be determined up it; and not ſpread itſelf in the elaboratory, or other place. The fire muſt be kept up ſo long as any of theſe fumes appear to riſe; and then permitted to go gradually out; and all acceſs of cold air muſt be cautiouſly prevented. When the crucibles are grown intirely cold, but not before, the uppermoſt may be taken off; and the cryſtal will be found coloured, ſome pieces like topazes, and ſome like rubies, and a variety of other ſtones."

It has been ſaid, that the cryſtals thus coloured have been cut; and produced fine imitations of the true ſtones: but the truth of the matter is, (notwithſtanding all pretenſion to more) that they do appear, when taken out of the crucible, to be well coloured and beautiful; yet on further examination it is found, that the whole effect is produced by a fallacious cauſe. For the cryſtals being cracked by the heat, it is almoſt univerſally the conſequence of being expoſed to this degree of heat,

the fumes having insinuated themselves into these cracks, and there producing the same effect as the paint used betwixt the two tables of doublets, the whole substance of the stone has the appearance of being tinged. But on due inspection, nevertheless, the crystals are found to be neither fit to be cut, on account of the flaws, nor to have acquired any colour, but what would instantly be destroyed on the separation of the several parts of the stones, into which they are divided by the cracks: so that this method, together with many others of the same kind for giving colours to crystals by cementation, will be found to elude the hopes of those, who try them with any confidence.

The other pretended method of colouring crystals, by fusing them, and imparting the various tinges to them, while in a melted state, is thus performed:

"Take of rock crystals any quantity; and put them in a covered crucible in a strong fire; where they must be continued for some time. Remove the crucible then out of the fire; and immediately throw the crystals into a vessel of clean cold water: from whence being again collected, they must be re calcined; and afterwards thrown into fresh water again in the same manner: and this operation must be repeated, till the crystals be so changed in their texture, by the flaws and cracks produced by the sudden change from heat to cold, that they may be easily levigated. Powder the crystals thus calcined; and, to three pounds of them, add two pounds of purified pearl-ashes, or a pound and a quarter of red lead, together with any of the tinging substances abovementioned, in the proportion directed for colouring glass or pastes; and fuse them in the same manner also, as has been before advised for other compositions. If the matter be found too difficult to be brought to a vitreous state, by this proportion of pearl-ashes or lead, borax or arsenic may be added, as in other cases, in order to form a more powerful flux."

The crystal thus treated produces however nothing more than a glass exactly of the same kind with that formed of the Lynn sand; which is in fact no other

than a grofs powder of cryftal; and neither of them differ very eſſentially from ſuch calcined flints, as are wholly free from colour. The ſuppoſition, therefore, that the cryſtal can be fuſed by this means, and being tinged while in that ſtate, reduced afterwards to its original hardneſs, is wholly groundleſs. For it cannot be fuſed by the heat of furnaces without the medium of ſome fluxing body added to it; and then its texture and properties are ſo changed, or rather the glaſs produced by the compoſition is ſo different from the cryſtal itſelf, that there does not appear to be the leaſt advantage in employing rock-cryſtal, in forming ſuch a compoſition, preferably to flints; even if they could be procured at the ſame expence; and required no greater trouble or labour in their uſe.

*Of doublets.*] The impracticability of imparting tinges to the body of cryſtals, while in their proper and natural ſtate, and the ſoftneſs of glaſs which renders ornaments made of it greatly inferior in wear to cryſtal, gave inducements to the introduction of colouring the ſurface of cryſtal, wrought into a proper form in ſuch manner, that the ſurfaces of two pieces ſo coloured being laid together, the effect might appear the ſame, as if the whole ſubſtance of the cryſtal had been tinged. The cryſtals (and ſometimes white tranſparent glaſs) ſo treated, were called doublets: and at one time prevailed greatly in uſe, on account of the advantages, with reſpect to wear, ſuch doublets had, when made of cryſtal, over glaſs, and the brightneſs of the colours, which could with certainty be given to counterfeit ſtones this way, when coloured glaſs could not be procured; or at leaſt not without a much greater expence. Doublets have not indeed the property which the others have of bearing to be ſet tranſparent; as is frequently required in drops of ear-rings and other ornaments. But when mounted in rings, or uſed in ſuch manner, that the ſides of the pieces, where the joint is made, cannot be inſpected, they have, when formed of cryſtal, the title to a preference to the coloured glaſs: and the art of managing them is therefore in ſome degree of the ſame

importance with that of preparing glaſs for the counterfeiting gems; and is therefore properly an appendix to it, as being intirely ſubſervient to the ſame intention. The manner of managing doublets is as follows:

Let the cryſtal or glaſs be firſt cut by the lapidaries in the manner of a brilliant: except that, in this caſe, the figure muſt be compoſed from two ſeparate ſtones, or parts of ſtones formed in the manner of the upper and under parts of a brilliant, if it was divided in an horizontal direction, a little lower than the middle. After the two plates of the intended ſtone are thus cut, and fitted ſo exactly, that no diviſion can appear when they are laid together, the upper part muſt be poliſhed ready for ſetting; and then the colour muſt be put betwixt the two plates by this method:

"Take of Venice or Cyprus turpentine two ſcruples; and add to it one ſcruple of the grains of maſtic choſen perfectly pure, and free from foulneſs, and previouſly powdered. Melt them together in a ſmall ſilver or braſs ſpoon ladle, or other veſſel, and put to them gradually any of the coloured ſubſtances below mentioned, being firſt well powdered; ſtirring them together as the colour is put in, that they may be thoroughly commixt. Warm then the doublets to the ſame degree of heat, as the melted mixture; and paint the upper ſurface of the lower part; and put the upper one inſtantly upon it; preſſing them to each other; but taking care that they may be conjoined in the moſt perfectly even manner. When the cement or paint is quite cold, and ſet, the redundant part of it, which has been preſſed out of the joint of the two pieces, ſhould be gently ſcraped off the ſide, till there be no appearance of any colour on the outſide of the doublets: and they ſhould then be ſkilfully ſet; obſerving to carry the mounting over the joint, that the upper piece may be well ſecured from ſeparating from the under one."

The colour of the ruby may be beſt imitated, by mixing a fourth part of carmine with ſome of the fineſt crimſon lake that can be procured: which may be beſt made for this purpoſe of Brazil wood.

The ſapphire may be counterfeited by very bright Pruſſian blue, mixed with a little of the above-mentioned crimſon lake, to give it a caſt of the purple. The Pruſſian blue ſhould not be very deep coloured, or but little of it ſhould be uſed: for otherwiſe, it will give a black ſhade that will be injurious to the luſtre of the doublets.

The emerald may be well counterfeited by diſtilled verdigriſe, with a little powdered aloes. But the mixture ſhould not be ſtrongly heated, nor kept long over the fire after the verdigriſe is added: for the colour is apt to be ſoon impaired by it.

The reſemblance of the garnet may be made by dragon's blood: which, if it cannot be procured of ſufficient brightneſs, may be helped by a very ſmall quantity of carmine.

The vinegar garnet may be imitated with great ſucceſs by the orange lake.

The amethyſt may be counterfeited by the mixture of ſome Pruſſian blue, with the crimſon lake: but the proportions can only be regulated by diſcretion; as different parcels of the lake and Pruſſian blue vary extremely in the degree of ſtrength of the colour.

The yellow topazes may be imitated, by mixing the powdered aloes with a little dragon's blood; or by good Spaniſh anatto: but the colour muſt be very ſparingly uſed, or the tinge will be too ſtrong for the appearance of that ſtone.

The cryſolite, hyacinth, vinegar garnet, eagle marine, and other ſuch weaker or more diluted colours, may be formed in the ſame manner, by leſſening the proportions of the colours, or by compounding them together correſpondently to the hue of the ſtone to be imitated; to which end it is proper to have an original ſtone, or an exact imitation of one at hand, when the mixture is made; in order to the more certain adapting the colours to the effect deſired. When theſe precautions are taken, and the operation well conducted, it is practicable to bring the doublets to ſo near a reſemblance of the true ſtones, that even the beſt judges cannot

diſtinguiſh them, when well ſet, without a peculiar manner of inſpection.

Where any kind of lake, or Pruſſian blue, is uſed for this purpoſe, it is beſt to grind or levigate it with ſpirit of turpentine inſtead of water; which will prevent its concreting again as it dries. The dragon's blood may be levigated with water: but the diſtilled verdigriſe muſt be powdered dry. All the ſubſtances uſed as tinges for doublets or foils muſt, however, be powdered as finely as poſſible: the brightneſs of the counterfeit ſtones for which they are uſed, depending very greatly on that.

There is, however, an eaſy method of diſtinguiſhing doublets: which is only to hold them betwixt the eye and light, in ſuch poſition, that the light may paſs through the upper part, and corners of the ſtone; which will then ſhow ſuch parts to be white; and that there is no colour in the body of the ſtone.

*Of the general nature and preparation of foils.*] Foils are thin plates or leaves of metal, that are put under ſtones, or compoſitions in imitation of ſtones, when they are ſet.

The intention of foils is, either to increaſe the luſtre or play of the ſtones, or more generally to improve the colour, by giving an additional force to the tinge, whether it be natural or artificial, by that of a ground of the ſame hue; which the foil is in this caſe made to be.

There are conſequently two kinds of foils. The one is colourleſs; where the effect of giving luſtre or play to the ſtone is produced by the poliſh of the ſurface, which makes it act as a mirror; and, by reflecting the light, prevent that deadneſs which attends the having a duller ground under the ſtone; and brings it, by the double refraction of the light that is cauſed, nearer to the effect of the diamond. The other is coloured with ſome pigment or ſtain of the ſame hue as the ſtone; or of ſome other, which is intended to modify and change the hue of the ſtone in ſome degree; as, where a yellow foil may be put under green, which is too much inclining to

the blue; or under crimſon, where it is deſired to have the appearance more orange or ſcarlet.

Foils may be made of copper or tin: and ſilver has been ſometimes uſed; with which it has been adviſed, for ſome purpoſes, to mix gold; but the expence of either is needleſs, as copper may be made to anſwer the ſame end.

Where coloured foils are wanted, copper may, therefore, be beſt úſed; and may be prepared for the purpoſe by the following means:

"Take copper plates beaten to a proper thickneſs; and paſs them betwixt a pair of fine ſteel rollers very cloſely ſet; and draw them as thin as is poſſible to retain a proper tenacity. Poliſh them with very fine whiting, or rotten ſtone, till they ſhine, and have as much brightneſs as can be given them; and they will then be fit to receive the colour."

But where the yellow or rather orange colour of the ground would be injurious to the effect, as in the caſe of purples, or crimſon red, the foil ſhould be whitened, which may be done by ſilvering it in the following manner:

"Take a ſmall quantity of ſilver, and diſſolve it in aquafortis; and then put bits of copper into the ſolution, to precipitate the ſilver; which being thus precipitated, the fluid muſt be poured off: and freſh water added to it, to waſh away all the remainder of the firſt fluid: after which, the ſilver muſt be dried. An equal weight of cream of tartar, and common ſalt, muſt then be ground with it, till the whole be reduced to a very fine powder: and with this mixture, the foils, being firſt ſlightly moiſtened, muſt be rubbed by the finger, or a bit of linen rag, till they be of the degree of whiteneſs deſired: after which, if it appear to be wanted, the poliſh muſt be refreſhed."

Inſtead of rolling, the more general practice is, to beat the copper plates, previouſly heated, betwixt two flat irons on an anvil, till they become of the thickneſs required; and then give to them an even ſurface, by a planiſhing hammer, before they are poliſhed: but the

uſe of the rollers is much more expeditious and effectual, where the quantity demanded can defray the expence of purchaſing them, with the other neceſſary work.

The tin foils are only uſed in the caſe of colourleſs ſtones, where quickſilver is employed: and they may be drawn out by the ſame rollers; but need not be further poliſhed; as that effect is produced by other means in this caſe.

*Of the colouring foils.*] There have been two methods invented for the colouring foils: the one by tinging the ſurface of the copper of the colour required, by means of ſmoke: the other by ſtaining or painting it with ſome pigment, or other colouring ſubſtance. The firſt is limited only to colours where blue is prevalent, and, being troubleſome and uncertain in the production, is not, on the whole, ſo eligible, in any caſe, as the latter: and I ſhall, therefore, omit giving any directions for the practice of it; as all colours deſired may be given to the foils by the other method: that is, by laying a pigment or other colouring ſubſtance on the ſurface, by means of ſome proper vehicle that may ſerve for ſpreading it, and fixing it to the copper as a cement.

The colours uſed for painting foils, may be tempered with either oil; water rendered duly viſcid by gum Arabic, or ſize, or varniſh: and as there is no preference of one method to the other, but in particular caſes, it is beſt to peruſe all of them, according to the occaſions that may be beſt ſerved. Where deep colours are wanted, oil is moſt proper; becauſe ſome pigments become wholly tranſparent in it; as lake or Pruſſian blue: but yellow and green may be better laid on in varniſh, as the yellow may be had in perfection from a tinge wholly diſſolved in ſpirit of wine, in the ſame manner as in the caſe of laquers; and the moſt beautiful green is to be produced by diſtilled verdigriſe, which is apt to loſe its colour, and turn black with oil. In common caſes, however, any of the colours may be, with little trouble, laid on with iſinglaſs ſize, in the ſame manner as the glazing colours uſed in miniature painting; for

which, ample directions will now be given. The beſt method of adapting foils to all the ſeveral purpoſes, is as follows:

For red, where the ruby is to be imitated, carmine, with a little lake uſed in iſinglaſs ſize, or ſhell-lac varniſh, is to be employed, if the glaſs or paſte be of a full crimſon, verging towards the purple. But if the glaſs incline to the ſcarlet, or orange, very bright lake (that is not purple) may be uſed alone in oil.—For the garnet red, dragon's blood, diſſolved in ſeed-lac varniſh, may be uſed:——and for the vinegar garnet, the orange lake, tempered with ſhell-lac varniſh, will be found excellent.

For the amethyſt, lake, with a little Pruſſian blue, uſed with oil, and very thinly ſpread on the foil, will completely anſwer the end.

For blue, where a deep colour, or the effect of the ſapphire is wanted, Pruſſian blue, that is not too deep, ſhould be uſed in oil: and it ſhould be ſpread more or leſs thinly on the foil, according to the lightneſs or deepneſs of which the colour is deſired to be.——For the eagle marine, common verdigriſe, with a little Pruſſian blue, tempered in ſhell-lac varniſh, may be uſed.

For yellow, where a full colour is deſired, the foil may be coloured with yellow laquer, laid on as for other purpoſes: and for the ſlighter colour of topazes, the burniſh and foil itſelf will be ſufficiently ſtrong without any addition.

For green, where a deep hue is required, the cryſtals of verdigriſe, tempered in ſhell-lac varniſh, ſhould be uſed: but where the emerald is to be imitated, a little yellow laquer ſhould be added, to bring the colour to a truer green, and leſs verging to the blue.

The ſtones of more diluted colour, ſuch as the amethyſt, topaz, vinegar garnet, and eagle marine, may be very cheaply imitated by tranſparent white glaſs, or paſte, even without foils. This is to be done, by tempering the colours above enumerated with turpentine and maſtic, treated in the manner directed as before, for doublets; and painting the ſocket in which the coun-

terfeit ſtone is to be ſet with the mixture; as well that as the ſocket and ſtone itſelf being previouſly heated. In this caſe, however, the ſtone ſhould be immediately ſet, and the ſocket cloſed upon it, before the mixture cool and grow hard.

The orange lake, abovementioned, was invented for this purpoſe, in which it has a beautiful effect; and was uſed with great ſucceſs by a conſiderable manufacturer. The colour it produces is that of the vinegar garnet; which it affords with great brightneſs.

The colours, above directed to be uſed in oil, ſhould be extremely well ground in oil of turpentine, and tempered with old nut or poppy oil; or, if time can be given for their drying, with ſtrong fat oil diluted with ſpirit of turpentine, which will gain a fine poliſh of itſelf.

The colours uſed in varniſh ſhould be, likewiſe, thoroughly well ground and mixed: and, in caſe of the dragon's blood, in the ſeed-lac varniſh and the laquer, the foils ſhould be warmed before they are laid on.

All the mixtures ſhould be laid on the foils with a broad ſoft bruſh; which muſt be paſſed from one end to the other; and no part ſhould be croſſed, or twice gone over; or, at leaſt, not till the firſt coat be dry; when, if the colour do not lie ſtrong enough, a ſecond coat, or even a third, may be given.

*Of foils for cryſtals, pebbles, or paſte, to give the luſtre and play of diamonds.*] The manner of preparing foils, ſo as to give colourleſs ſtones the greateſt degree of play and luſtre, is, by raiſing ſo high a poliſh or ſmoothneſs on the ſurface, as to give them the effect of a mirror; which can only be done in a perfect manner by the uſe of quickſilver applied in the ſame general way, as in the caſe of looking-glaſs. The method by which it may be beſt performed, is as follows:

"Take leaves of tin, prepared in the ſame manner as for ſilvering looking-glaſſes; and cut them into ſmall pieces of ſuch ſize as to cover the ſurface of the ſocket of the ſtones that are to be ſet. Lay three of theſe then one upon another; and, having moiſtened the

inside of the socket with thin gum water, and suffered it to become again so dry, that only a slight stickiness remains, put the three pieces of leaves, lying on each other, into it, and adapt them to the surface, in as even a manner as possible. When this is done, heat the socket, and fill it with warm quicksilver; which must be suffered to continue in it three or four minutes, and then gently poured out. The stone must then be thrust into the socket, and closed with it; care having been taken to give such room for it, that it may enter without stripping off the tin and quicksilver from any part of the surface. The work should be well closed round the stone, to prevent the tin and quicksilver, contained in the socket, from being shaken out by any violence."

The lustre of stones, set in this manner, will continue longer, than when they are set in the common way; as the cavity round them being filled in this manner, there will be no passage found for moisture; which is so injurious to the wear of stones treated in any other way.

This kind of foil gives some lustre to glass, or other transparent matter, which has little of itself: but to stones, or pastes, that have some share of play, it gives a most beautiful brilliance. It has been but little practised hitherto; I suppose from an ignorance of the manner of doing it: for, indeed, I never heard of more than one person, and he is now some time deceased, who performed it to perfection: and he gave the stones a surprising lustre, that made them not distinguishable from diamonds even by day-light. There is, nevertheless, at present, one disadvantage attending this method, as it is now practised: which is, that it can be only performed in the case of stones with a flat bottom. In consequence of which, the rose or table diamonds, only, can be imitated by it. But though the manner of doing it has not been hitherto discovered, yet it is certainly not impossible to contrive some way of setting stones of the cut of brilliants in this manner: in which case, if any of the crystal species, such as

those called Bristol stones, Kerry stones, &c. were to be used, their far greater hardness, as well as much higher lustre, when treated in this way, would render them far superior to pastes.

## *Of Cements.*

CEMENTS require to be of very various compositions, and different with respect to the nature of the ingredients, according to the different manner in which they are to be applied; and the substances they are to conjoin. The kinds of cement used for common purposes pass under the denomination of glues, sizes, pastes, and lutes: but some, that are used for extraordinary occasions, retain only the general name of cements.

*Preparation of isinglass glue.*] "Isinglass glue is made by dissolving beaten isinglass in water by boiling; and, having strained it through a coarse linen cloth, evaporating it again to such a consistence, that, being cold, the glue will be perfectly hard and dry."—A great improvement is said to be made in this glue by adding spirit of wine or brandy to it after it is strained, and then renewing the evaporation till it gain the due consistence. Some soak the isinglass in the spirit of brandy for some time before it is dissolved, in order to make the glue; and add no water, but let the spirit supply the place of it. But it is not clear, from trial, that either of these practices render the glue better. This isinglass glue is far preferable to common glue for nicer purposes; being much stronger, and less liable to be softened either by heat or moisture.

*Preparation of parchment glue.*] "Take one pound of parchment, and boil it, in six quarts of water, till the quantity be reduced to one quart: strain off the fluid from the dregs; and then boil it again, till it be of the consistence of glue."——The same may be done with glovers' cuttings of leather, which make a colourless glue, if not burned in the evaporation of the water.

*Preparation of a very ſtrong compound glue.*] "Take common glue in very ſmall or thin bits, and iſinglaſs glue; and infuſe them in as much ſpirit of wine as will cover them, for at leaſt twenty-four hours. Then melt the whole together; and, while they are over the fire, add as much powdered chalk as will render them an opake white."—The infuſion in the ſpirit of wine has been directed in the recipes given for this glue; but the remark on the uſe of it in the preceding article will hold good alſo in this: and the mixture may be made with water only.

*Preparation of a very ſtrong glue that will reſiſt moiſture.*] "Diſſolve gum ſanderac, and maſtic, of each two ounces, in a pint of ſpirit of wine; adding about an ounce of clear turpentine. Then take equal parts of iſinglaſs, and parchment glue, made according to the directions in the preceding article; and, having beaten the iſinglaſs into ſmall bits, as for common uſes, and reduced the glue to the ſame ſtate, pour the ſolution of the gums upon them; and melt the whole in a veſſel well covered; avoiding ſo great a heat as that of boiling water. When melted, ſtrain the glue through a coarſe linen cloth; and then putting it again over the fire, add about an ounce of powdered glaſs."—This preparation may be beſt managed in balneo mariæ, which will prevent the matter burning to the veſſel; or the ſpirit of wine from taking fire: and indeed it is better to uſe the ſame method for all the evaporations of nicer glues, and ſizes; but, in that caſe, leſs water than the proportion directed, ſhould be added to the materials. A very ſtrong glue, that will reſiſt water, may be alſo made by adding half a pound of common glue or iſinglaſs glue to two quarts of ſkimmed milk, and then evaporating the mixture to the due conſiſtence of the glue.

*Preparation of lip glue, for extemporaneouſly cementing paper, ſilk, and thin leather, &c.*]—"Take of iſinglaſs glue, and parchment glue, each one ounce, of ſugar candy, and gum tragacanth, each two drachms. Add to them an ounce of water, and boil the whole together, till the mixture appear, when cold, of the pro-

per consistence of glue. Then form it into small rolls, or any other figure, that may be most convenient."—This glue being wet with the tongue, and rubbed on the edges of the paper, silk, &c. that are to be cemented, will, on their being laid together, and suffered to dry, unite them as firmly as any other part of the substance.

*Of sizes.*] Common size is manufactured in the same manner, and generally by the same people, as glue. It is indeed glue left in a moisture state, by discontinuing the evaporation before it is brought to a dry consistence: and therefore further particulars respecting the manufacture of it are needless here.—Isinglass size may also be prepared, in the manner above directed for the glue, by increasing the proportion of the water for dissolving it: and the same holds good of parchment size. A better sort of the common size, which may be likewise made by treating cuttings of glovers' leather in the same manner.

*Of pastes.*] Paste for cementing is formed principally of wheaten flour boiled in water till it be of a glutinous or viscid consistence. It may be prepared of those ingredients simply for common purposes: but when it is used by book-binders, or for paper hangings to rooms, it is usual to mix a fourth, fifth or sixth of the weight of the flower of powdered resin; and where it is wanted still more tenacious, gum Arabic, or any kind of size, may be added. In order to prevent the paste used for hanging rooms with paper, or where it is employed in any other way that may render it subject to such accidents, from being gnawed by rats and mice, powdered glass is sometimes mixed with it. But the most effectual and easy remedy is to dissolve a little sublimate, in the proportion of a drachm to a quart, in the water employed for making the paste; which will hinder, not only rats and mice, but any other kind of vermin and insects, from preying on the paste.

*Of lutes.*] Lutes are cements employed for making good the joints of glasses put together, or other such purposes, in chemical operations. In a general view,

the preparation of them properly belongs to the art of chemiſtry only: but as they are nevertheleſs ſometimes uſed in other arts, it may be expedient to ſhow here the manner of compounding them. In the making good junctures, where the heat is not ſufficient to burn paper or vegetable ſubſtances, the following mixture, which is eaſily made, will effectually anſwer the purpoſe. Take a mixture of linſeed meal or wheaten flour and whiting, in the proportion of one part of the firſt to two of the laſt, tempered with a ſolution of gum Senegal or Arabic in water, and ſpread upon the joint, a narrow piece ſmeared with the ſame being put over it and preſſed cloſe. A piece of bladder ſmeared with gum water, or the glair of eggs, and fitted to the glaſſes over the joint, will alſo anſwer the ſame end. But in the rectification of ſpirit of wine, or other ſuch volatile ſubſtances, where the waſte made by the eſcape of the vapour may be material, a ſtronger lute formed of quicklime, tempered to a proper conſiſtence with drying oil, ſhould be uſed. This mixture ſhould be made at the time it is wanted, as it very ſoon becomes dry and untractable: and great care muſt be taken, where it is employed, to manage the heat in ſuch manner, that the vapour may not riſe ſo faſt as to heat the veſſels beyond the due point; for this lute renders the glaſſes joined together by it as one intire body; and will reſiſt the expanſive force of the vapour to ſo great a degree, that the glaſſes will frequently burſt before it will give way. Where lute is to be uſed in places liable to be ſo heated as to burn vegetable or animal ſubſtances, it may be thus compounded. Take two parts of green vitriol calcined to redneſs, one part of the ſcoria or clinkers of a ſmith's forge well levigated, and an equal quantity of Windſor loom or Sturbridge clay dried and powdered: temper them to a proper conſiſtence with the blood of any beaſt; ſome ſhort hair, of which the proportion may be as a twentieth part to the whole, being beaten up with them, and ſpread them over the juncture. In caſes of little importance, a compoſition of ſand, clay, and dung of horſes tempered with water, may be uſed.

*Preparation of cement for joining broken glaſſes, china, &c.*] The cement, which has been moſt approved for uniting glaſs, china, or earthen ware, as alſo the parts of metalline bodies (where ſoldering is not expedient) is thus prepared.—"Take two ounces of good glue, and ſteep it for a night in diſtilled vinegar: boil them together the next day; and having beaten a clove of garlic with half an ounce of ox-gall into a ſoft pulp, ſtrain the juice through a linen cloth, uſing preſſure, and add it to the glue and vinegar. Take then of ſanderac powdered, and turpentine, each one drachm, and of ſarcocol, and maſtic, powdered, each half a drachm; and put them into a bottle with an ounce of highly rectified ſpirit of wine. Stop the bottle; and let the mixture ſtand for three hours in a gentle heat; frequently ſhaking it. Mix this tincture alſo with the glue while hot; and ſtir them well together with a ſtick or tobacco-pipe, till part of the moiſture be evaporated; and then take the compoſition from the fire; and it will be fit for uſe. When this cement is to be applied, it muſt be dipped in vinegar; and then melted in a proper veſſel, with a gentle heat; and if ſtones are to be cemented, it is proper to mix with it a little powdered tripoli or chalk; or, if glaſs is to be conjoined, powdered glaſs ſhould be ſubſtituted."——I ſee no reaſon why common vinegar ſhould not be equally proper for this purpoſe with the diſtilled; nor indeed am I very certain that vinegar improves at all the cementing property of the compoſition. For the uniting the parts of broken china or earthen ware veſſels, as alſo glaſs where the rendering the joint viſible is not of conſequence, the following compoſition, which is much more eaſily prepared, may be ſubſtituted for the foregoing: "Take an ounce of cheeſe, devoid of fat: grate it as ſmall as poſſible; and put it, with an equal weight of quicklime, into three ounces of ſkimmed milk. Mix them thoroughly together; and uſe the compoſition immediately."—Where the broken veſſels are for ſervice only, and the appearance is not to be regarded, the joints may be made equally ſtrong with any other part

of the glaſs, by putting a ſlip of thin paper, or linen, ſmeared with this cement, over them, after they are well joined together by it. This method will make a great ſaving in the caſe of glaſſes employed for chemical, or other ſimilar operations. A cement of the ſame nature may be made by tempering quicklime with the curd of milk, till it be of a due conſiſtence for uſe. The curd, in this caſe, ſhould be as free as poſſible from the cream or oil of the milk. On this account it ſhould be made of milk from which the cream has been well ſkimmed off; or the kind of curd commonly ſold in the markets, made of whey, and the milk from which butter has been extracted, commonly called butter-milk. This cement ſhould be uſed in the ſame manner as the preceding: and they may be applied to ſtones, marble, &c. with equal advantage as the more compound one above given, and is much more eaſily and cheaper prepared. Drying oil with white lead is alſo frequently uſed for cementing china, and earthen-ware: but where it is not neceſſary the veſſels ſhould endure heat or moiſture, iſinglaſs glue with a little tripoli or chalk is better.

*Preparation of common cement for joining alabaſter, marble, porphyry or other ſtones.*] "Take of bees wax two pounds, and of reſin one pound. Melt them; and add one pound and a half of the ſame kind of matter powdered, as the body to be cemented is compoſed of; ſtrewing it into the melted mixture, and ſtirring them well together; and afterwards kneading the maſs in water, that the powder may be thoroughly incorporated with the wax and reſin. The proportion of the powdered matter may be varied, where required, in order to bring the cement nearer to the colour of the body on which it is employed."—This cement muſt be heated when applied; as muſt alſo the parts of the ſubject to be cemented together; and care muſt be taken, likewiſe, that they be thoroughly dry. It appears to me, that the proportion of the bees wax is greater than it ought to be: but I received this recipe from too good an authority to preſume to alter it. When this compoſition is properly managed, it forms an extremely good ce-

ment, which will even ſuſpend a projecting body of conſiderable weight, after it is thoroughly dry and ſet: and is therefore of great uſe to all carvers in ſtone, or others who may have occaſion to join together the parts of bodies of this nature.

*Of cements for rock-work, reſervoirs, and other ſuch purpoſes.*] A variety of compoſitions are uſed as cements for purpoſes of this kind: in the application of which, regard ſhould be had to the ſituation where they are employed with reſpect to moiſture and dryneſs; as well as to the magnitude of the bodies to be conjoined together, or the vacuities or fiſſures that are to be made good. Where a great quantity of cement is wanted for coarſer uſes, the coal-aſh mortar (or Welſh tarras as it is called) is the cheapeſt and beſt; and will hold extremely well, not only where it is conſtantly kept wet or dry; but even where it is ſometimes dry and at others wet. But where it is liable to be expoſed to wet and froſt, this cement ſhould, at its being laid on, be ſuffered to dry thoroughly before any moiſture have acceſs to it; and, in that caſe, it will likewiſe be a great improvement to temper it with the blood of any beaſt. This mortar or Welſh tarras muſt be formed of one part lime and two parts of well-ſifted coal aſhes; and they muſt be thoroughly mixed by being beaten together: for, on the perfect commixture of the ingredients, the goodneſs of the compoſition depends. Where the cement is to remain continually under water, the true tarras is commonly uſed; and will very well anſwer the purpoſe. It may be formed of two parts of lime, and one part of plaiſter of Paris: which ſhould be thoroughly well beaten together; and then uſed immediately. For the fixing ſhells, and other ſuch nice purpoſes, putty is moſt generally uſed. It may be formed for this purpoſe of quicklime, and drying oil, mixed with an equal quantity of linſeed oil; or, where the drying quicker is not neceſſary, it may be made with lime and crude linſeed oil, without the drying oil. The ſtone cement, prepared as above of the bees wax and

reſin, is alſo an extremely good compoſition for this purpoſe. But reſin, pitch, and brick-duſt, in equal parts, melted together and uſed hot, are much the cheapeſt cement for ſhell-work; and will perform that office very well, provided the bodies they are to conjoin be perfectly dry when they are uſed.

END *of the* THIRD PART.

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