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OF

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THE SIXTH EDITION.

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1823.

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## P R E F A C E.

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As it may be thought a presumption in me to give this little work the name of Improvements on Mr. Boyle's Experiments, as if I intended thereby to insinuate that those valuable Experiments were imperfect, I judged it not amiss, by way of apology, to assure the Reader that I have too great an esteem for all the excellent performances of that truly noble and experienced Author, not to pay them the deference, and to peruse them with that admiration, they so justly deserve.

When first I took these Essays into my hands, I indeed expected (not knowing the nature and design of them till I read them) to find nothing but recipes ready for me to apply directly to the purpose I wanted them for; but I had not gone over some few of them without being soon convinced of my mistake, and easily discovered that the honourable and generous Author had designed these

## PREFACE.

elaborate pieces only as foundations for others to improve and build upon.

This, indeed, was a great disappointment to me, and rendered the work I had in hand more difficult than I could have wished; but as I was determined to go through with what I had begun, the repeating and varying of the processes soon gave me the satisfaction of seeing my unlooked-for and additional trouble well rewarded with new and useful appearances and effects; which, perhaps, did not appear to that gentleman, as he acted on more sublime principles, and with more extensive views, than persons of my infinitely inferior capacity can pretend to.

In this sense it is, therefore, that I have taken the liberty of calling the few following *tentamina*, Improvements on Mr. Boyle's Experiments, and hope that, when taken in this light, I shall not be censured by the world, as assuming an improper title, or of attempting to eclipse the glory of one of the greatest men the learned world has ever been honoured with.

## PREFACE.

It may likewise be surmised, that the many treatises that have appeared in the world on this subject, both before and after the writing of Mr. Boyle's Essays, will make this work unnecessary, useless, and even superfluous: to take away the force of this objection, I will only add, that as my natural aversion to impose any thing upon the Public, that was copied from others, (as has been too frequently done, without trying whether the things they published were agreeable to truth,) would have been sufficient to hinder me from this undertaking, so I have offered nothing in the following sheets, but what I have myself experienced. And as I do not remember to have seen any thing herein contained, in the many Authors I have read on this subject, I thought my labours might not be altogether useless, unprofitable, or unacceptable, to the curious, as well as the Artist, to whose patience and favour I recommend them, and whose approbation I shall be very proud of.

Note.—For the ease and conveniency of those Readers that have not leisure to have recourse to

## PREFACE.

Mr. Boyle's Essays, and others who have not that Book by them, I have transcribed from that Author the Experiments whereon the following were made, and placed them at the head of the Improvements on each of them; whereby it will at once appear what the design of those Experiments was, and of what use my operations thereon will be.

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&c. &c. &c.

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PRACTICAL IMPROVEMENTS ON  
COLOURS.

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**T**HAT the method I have taken in setting down the following trials, by beginning at the Twentieth of Mr. Boyle's Experiments, may not appear strange and irregular, it will not be improper to acquaint the reader, that hitherto I have found nothing in any of the preceding, intermediate, and the subsequent experiments, not here taken notice of, but what either not related to, or interfered with, the present subject, and therefore make no mention of them. This being what I thought necessary to premise, shall proceed to the business.

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EXPERIMENT XX.

“TAKE good syrup of violets, impregnated with the tincture of the flowers; drop a little of it upon white paper (for by that means the change of colour

will be more conspicuous, and the experiment may be practised in smaller quantities), and on this liquor let fall two or three drops of spirit, either of salt or vinegar, or almost any other eminently acid liquor; and upon the mixture of these you shall find the syrup immediately turned red; and the way of effecting such a change has not been unknown to divers persons, who have produced the like by spirit of vitriol, or juice of lemons, but have groundlessly ascribed the effect to some peculiar quality of those two liquors, whereas (as we have already intimated) almost any acid salt will turn syrup of violets red. But, to improve the experiment, let me add, what has not, that I know of, been hitherto observed; and has, when we first shewed it them, appeared something strange, even to those that have been inquisitive into the nature of colours, namely, that if, instead of spirit of salt, or that of vinegar, you drop upon the syrup of violets a little oil of tartar, *per deliquium*, or the like quantity of solution of potashes, and rub them together with your finger, you shall find the blue colour of the syrup turned in a moment into a perfect green; and the like may be performed by divers other liquors, as we may have occasion elsewhere to inform you."

The annotation on this experiment differing little from what is there said, except what relates to the *lignum nephriticum*, it is useless to transcribe it.

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## EXPERIMENT XXI.

"THERE is a weed, more known to ploughmen than beloved by them, whose flowers, from their colour, are commonly called blue-bottles, and corn-weed, from their growing among corn. These

flowers some ladies do, upon the account of their lovely colour, think worth the being candied; which, when they are, they will long retain so fair a colour, as makes them a very fine salad in the winter. But I have tried that, when they are freshly gathered, they will afford a juice which, when newly expressed (for in some cases it will soon enough degenerate), affords a very deep and pleasant blue. Now, to draw this to our present scope, by dropping on this fresh juice a little spirit of salt, that being the acid spirit I had then at hand, it immediately turned, as I predicted, into a red. And if, instead of the sour spirit, I mingled with it a little strong solution of an alcalizate salt, it did presently disclose a lovely green; the same changes being, by those different sorts of saline liquors, producible in this natural juice, that we lately mentioned to have happened to that fictitious mixture, the syrup of violets. And I remember that, finding this liquor blue, when freshly made, to be capable of serving in a pen for an ink of that colour, I attempted, by moistening one part of a piece of white paper with the spirit of salt I have been mentioning, and another with some alcalizate, or volatile liquor, to draw a line on the leisurely-dried paper, that should, even before the ink was dry, appear partly blue, partly red, and partly green; but though the latter part of the experiment succeeded not well, (whether because volatile salts are too fugitive to be retained in the paper, and alcalizate ones are too unctuous, or so apt to draw moisture from the air, that they keep the paper from drying well), yet the former part succeeded well enough; the blue and red being conspicuous enough to afford a surprising spectacle to those I acquaint not with (what I willingly allow you to call) the trick."

There is but very little in these two experiments more than for speculation; for, if a magistry be made, either of the expressed juice of the violets or the blue-bottles, or from the tincture made by infusing the

flowers dried, the colours, whether green or blue will be no more permanent than the tinctures; for when used in oil, they immediately turn red, and in water-colouring they will stand but a short time which may be supposed the reason why pigments of these two colours, made from vegetables, have been long out of use; notwithstanding all the great encomiums of several authors on the methods of making them, after the directions of Neri, in his Art of Glass, of which Mr. Boyle is likewise pleased to take some notice, at the close of his 49th Experiment.

What I have now said, may also shew how likely it is to make a lasting blue, not inferior to ultramarine, from the Cyanus (mentioned in this twenty-first experiment), after a manuscript of Mr. Boyle, said to be obtained from the late Lord Carlton; since, by what I, as well as many more, have tried, it is not only improbable, but impossible, to make that a durable colour, which is naturally so subject to immediate alteration on the approach of an acid, alcalizate, or a sulphureous salt. It is true, that the colour made from the cyanus is not quite so soon changed as that from violets, the latter having more red intermixed with the blue than the other; yet the salts have the same effect on the one as the other, which can by no means be prevented.

There are no vegetable substances, at least amongst the many that I have made trials upon, from which blue or green tinctures, that are truly lasting, can be produced. Even indigo, which has such a very great body, is durable no way but in printed calicoes and linen; for, though it does last a long while in dyed stuffs, it still goes off in time; and in painting in oil or water-colours, it is so bad, that it is very rarely used. The lately-invented liquor also prepared thereof, for staining the linen and calico, if not immediately used, will fade and die away. And as for the pigment called *litmus*, the blue tincture thereof, which is sometimes made use of, is so changeable, that the

air alone, without the help of any acid, will soon turn it red. Nor is the green tincture made from the violets, or corn-flowers, as taught in these two experiments, more lasting than the blue; the greenness, how fine soever it does appear, presently changes into a dirty brown, without the addition of any salt, and not to a red, as the blue colours are apt to do. The red colour, also, that is produced from them by an acid, is but of little value, the first beauty of the colour soon flying off. What is mentioned in the annotation on the twentieth experiment, concerning the *lignum nephriticum*, is of no service in the way of colouring, its only use being to shew the various effects the rays of light have to produce and change some colours, as may be more amply seen in the tenth experiment, page 199, &c. for the tincture of that wood is but of a dirty yellow colour, and can be turned to no other use than it is there designed for, with respect to colours, and therefore I shall take no further notice of it. In the annotation on the twenty-first experiment, Mr. Boyle says, "That when he purposely dissolved blue vitriol in fair water, and thereby sufficiently imbued the liquor with that colour, a lixivate liquor and a urinous salt, being copiously poured upon distinct parcels of it, did each of them, though perhaps with some difference, turn the liquor not green, but of a deep yellowish colour, almost like that of yellow ochre, which colour the precipitated corpuscles retained, when they had leisurely subsided in the bottom." How that judicious gentleman came to assert this, I cannot conceive, unless by mistake he mentions blue in the stead of white vitriol; for the latter does yield such a tincture and precipitation; which last, when freed from the salts, may be used in the painting way; but, upon repeated trials, I have found, that the blue vitriol, treated in the manner there mentioned, makes both a tincture and a powder, of a pale sea-green colour.

As this experiment relates chiefly to blue tinctures, it may not be foreign to the subject to add here what use may be made of the vegetable, known in the shops by the name of *litmus*, though the Hon. Mr. Boyle does particularly mention his trials thereon, in the forty-fourth experiment, pages 333 and 334.

What that most ingenious author says, concerning the various phænomena that appeared upon the additions of different salts, will in some cases serve to our present purpose, so far as those salts are a means of producing two, if not three, of the tinctures there set down; for that it is not at all practicable to produce a yellow from it that can be of any use, is, because the yellow appearance in that experiment proceeds only from the thinness of the colour, and is no more than a too much diluted red changed to a yellow by the rays of light falling on the surface of the liquor, as may be also observed in such a diluted purple tincture of cochineal, logwood, and such like, that otherwise have not the least taint of yellow: for, by all the various trials I have made, I could never produce a yellow tincture like that of a topaz from it.

The only tinctures, then, that I could make of it, to be useful, were, a blue, a red inclining to crimson, and sometimes a purple; this last not always succeeding alike, the least acidity turning it red: The method that will best answer making a blue tincture, that will be least subject to change reddish, is either to extract the colour with a strong lixivium of pot-ashes, or with soap-lye: but great care must be taken to let no alum, or any other acid, come to it; for any thing of that kind will not only destroy the colour, but precipitate it; and even in spring-water it will not be so good a blue.

To make a red tincture of *litmus* is not so difficult, almost every thing, even the air itself, contributing thereto, as may be seen from the cautions just now given about the blue. To effect this, you need only to infuse a sufficient quantity of *litmus* in alum-water,

acidulated with a few drops of aquafortis, or spirits of salt, and you will have a most beautiful red tincture, which, being mixed with a little gum-water, will serve for illuminating maps and prints, for writing, or any other purposes where tinctures are useful.

Lastly, To make a purple tincture, there is no other way than by extracting the colour in limpid water, with the help of any salt, and if it is to be used with gum, no other will do but shreds of leather, or gum tragacanth, boiled in water; for gum arabic, or senegal, will help to make it red. It must also be observed, that to make a red tincture, more litmus is required in proportion to water, than for the other two colours, the acid not drawing the colour out so well as a lixivate salt will do.

It will perhaps be here expected, that I should shew the way of making powders or magisteries from the above tinctures; but I found the making of them so difficult, and so much inferior to others that will be hereafter mentioned, that I thought it needless to speak of it; yet if any body should be desirous to try what may be done by them, it will be necessary to observe, that a purple powder cannot be made from the litmus, and that powders are made from the other two tinctures, by precipitating them with the contrary menstrums, viz. the blue with alum-water, and the red with pot-ash water, which produces a very odd effect; for the blue tincture will yield a reddish colour, and the red a bluish one.

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## EXPERIMENT XXII.

“OUR next experiment will perhaps seem to be of a contrary nature to the two former, made upon syrup of violets and juice of blue-bottles. For as in

them, by the infusion of oil of tartar, a bluish liquor is made green, so in this, by the sole mixture of the same oil, a greenish liquor becomes blue. The hint of this experiment was given us by the practice of some Italian painters, who being wont to counterfeit ultramarine azure, as they call it, by grinding verdigrise with sal-ammoniac, and some other saline ingredients, and letting them rot (as they imagine) for a good while together in a dunghill, we supposed that the change of colour wrought in the verdigrise, by this way of preparation, must proceed from the action of certain volatile and alcalizate salts, abounding in some of the mingled concretes, and brought to make a farther dissolution of the copper abounding in the verdigrise, and therefore conjectured, that if both the verdigrise and such salts were dissolved in fair water, the small parts of both being therein more subdivided and set at liberty, would have better access to each other, and thereby incorporate much more suddenly: And accordingly we found, that if, upon a strong solution of good French verdigrise (for it is that we are wont to employ as the best) you pour a just quantity of oil of tartar, and shake them well together, you shall immediately see a notable change of colour, and the mixture will grow thick, and not transparent; but if you stay awhile, till the grosser part be precipitated to, and settled in, the bottom, you may obtain a clear liquor of a very lovely colour, and exceedingly delightful to the eye. But you must have a care to drop in a competent quantity of oil of tartar, for else the colour will not be so deep and rich; and if, instead of this oil, you employ a clear lixivium of pot-ashes, you may have an azure somewhat lighter or paler than, and therefore differing from, the former. And if, instead of either of these liquors, you make use of spirit of urine, or of hartshorn, you may, according to the quantity and quality of the spirit you pour in, obtain a farther variety (though scarce considerable) of ce-

ruleous liquors: And yet, lately, by the help of this urinous spirit, we made a blue liquor, which not a few ingenious persons, and, among them, some whose profession makes them conversant in colours, have looked upon with wonder. But these azure-coloured liquors should be free from the subsiding matter, which the salts of tartar, or urine, precipitate out of them, rather by being decanted, than by filtration: for by the latter of these ways, we have sometimes found the colour of them very much impaired, and little superior to that of the grosser substance that is left in the filtre."

Although the subject of this experiment was not much for my purpose, I was nevertheless willing to make it as useful as I could to others, and therefore was induced to make the following remarks thereon:—As for the hint the author gives of the practice of some Italian painters, who counterfeit the colour of the ultramarine, by grinding verdigrise with sal-ammoniac, &c., and burying it so for some time in a dunghill; I cannot see how that could answer the design, because the strong acidity that is contained in the verdigrise is so corrosive, that it not only destroys all the colours it comes near, or is mixed with, but it is also impossible, by any means, either by volatile or alkalizate salts, to prevent its turning green, as well when used in oil as in water; the air itself soon taking off all resemblance of blue. Nevertheless I had a mind to try if I could not find out some means to deprive the verdigrise from its corroding quality, or at least so to blunt the points of the salts, as to render it more useful and less offensive than it is at present: For this purpose I chose rather to make use of distilled, than of crude, verdigrise, the latter yielding so little colour in proportion to its bulk; whereas the other entirely dissolves almost in all menstruums, and, in some, so well as to need no filtration.

After having made as many trials as I thought worth while, there were but two, out of a great number, that to me seemed to deserve notice; of both which I will set down the processes and use.

First, I took an ounce of the distilled verdigrise, and having reduced it to a very fine powder, dissolved it in four ounces of spirits of hartshorn, which produced a very beautiful deep ceruleous tincture: But though this colour did appear of such a rich blue hue, that it rather inclined to a purple than a green, yet, being put into a phial, and held between the eye and the light, the surface discovered a faint resemblance of a blue green, and being wrote with, or spread on white paper, there was, as soon as dry, a manifest strong appearance of a sea-green; which, therefore, I judged to be serviceable to gentlemen that delighted in colouring perspective views, maps, &c.

But to make the use of this tincture as extensive as possible, I was desirous to try what effect it would have to precipitate the verdigrise. To do this, I proceeded according to the usual method of precipitating acids with alkalies, as before mentioned; but I found myself deceived by the event; for the verdigrise, though an acid, would not be struck down with a lixivate alkaleous liquor or salt; wherefore I was obliged to have recourse to another method, and took some of my alum-water, (which is made by boiling an uncertain quantity of alum in water till all is dissolved, and, when quite cold, decanted from the alum that subsides,) and added to it an equal proportion of the tincture in a large phial, when, after a little effervescence, I had the pleasure to see a fine blue-green powder settle to the bottom; which, being washed well with warm water, till the water came off as sweet as it was put on, I spread on clean white tiles to dry, in a place free from dust. But if it happens that the colour does not all precipitate at first,

then the tinctured liquor must be poured off in another phial, and precipitated with fresh alum-water, till all the colour is taken out of the menstruum; though this last powder does not come off so deep as the first, because of the additional quantity of alum. By this method I perceived, however, with great satisfaction, that, notwithstanding that the precipitation was performed with an acid, the powder was almost entirely free from those corroding noxious qualities, so pernicious and offensive in the verdigrise, which I imputed to its being dissolved in the alkali-ze spirit. This powder will readily incorporate with gum-water or oil, and makes a very lively pleasant colour in both ways of painting. I will freely acknowledge that it has not so great a body as the verdigrise, nor will bear so much white lead as that: but then, on the other hand, it is not so nauseous, and covers better without white than the other does.

The second way that I found best to free verdigrise from its bad qualities, and to make it more durable, even in the air, (on both which accounts most people are deterred from using it,) was by dissolving the fine powder in alum-water, and precipitating it with a sufficient quantity of oil of tartar, per deliquium, or a lixivium of pot-ashes, by either of which a green powder is obtained, which, being washed and dried, as above, became equally useful to the first.

From these two processes it will be easily conceived how unlikely it is to bring verdigrise to the hue of ultramarine; for if, by dissolving it in the most active alkalizate spirit, or precipitating it with the strongest lixivial salt, nothing better than a sea-green powder can be produced, how can it with reason be supposed, that grinding it with sal-ammoniac (which is an acid), though mixt with lime, to make the salt more volatile and active, and burying it in a dunghill, should so much alter the colour as to make it a permanent blue; and even to equal ultramarine? For it will, I

believe, be allowed by all who are acquainted with the nature of volatiles, that, let the change that is occasioned thereby in colours be what it will, as soon as the volatile particles are gone off, the original matter differs little, if at all, from its pristine state; so that if any lasting change can be produced, it must, in my humble opinion, be done by a fixed alkalizate salt; and yet I have found, by experience, that verdigrise ground with lime, which, I think is as little liable to lose its strength as any alkali whatsoever, though as well incorporated as possible, will, when mixt up with oil for painting, soon acquire a perfect green teint, though, before mixture, a beautiful blue.

I have continued longer on the subject than I should, only to shew that the greatest men are not only entirely free from the impositions of artful ill-designing men, who can, for the sake of lucre, occasionally assume the appearance of honesty and ingenuity to deceive mankind, without distinction, or fear of being detected.

Yet, before I leave treating on this drug, it may not be altogether unacceptable if I add a process communicated to me some years ago by a friend of mine, and which I have since often made use of with great satisfaction. The recipe is as follows:—

Take of distilled verdigrise one pound; rhenish tartar four ounces; let both be reduced to a very fine powder, and put into two quarts of water, and a pint of the best vinegar; when it has stood to digest three days and three nights, and the vessel shaken often in that time, filter the liquor through a paper, and boil it over a gentle fire in the open air, to the quantity of a pint; but great care must be taken that it boils not too fast, lest the colour be burnt and spoiled. This is an excellent green tincture for colouring maps, prints, &c., and may be used a sink. It will likewise serve, before it is boiled, for staining of ivory green, by laying the ivory therein for some

days, till it acquires a deep colour. The smell of the verdigrise may be taken off by putting the stained ivory a day or two in clear urine.

N.B. This method of staining has been approved of by several curious persons, as the best that has of late years been practised.

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### EXPERIMENT XXIV.

“ IT may (Pyrophilus) somewhat serve to illustrate, not only the doctrine of pigments and of colours, but divers other parts of corpuscular philosophy, as that explicates odours and many other things, not as the schools, by airy qualities, but by real, though extremely minute, bodies; to examine how much of the colourless liquor a very small parcel of a pigment may imbue with a discernible colour: and though there be scarce any thing of preciseness to be expected from such trials, yet I presumed, that, at least, I should be able to shew a much farther subdivision of the parts of matter into visible particles, than I have hitherto found taken notice of, and than most men would imagine; nobody, that I know of, having yet attempted to reduce this matter to any measure. The bodies the most promising for such a purpose, might seem to be the metals, especially gold, because of the minuteness of its parts, which might be argued from the incomparable closeness of its texture. But though we tried a solution of gold, made in aquaregia first, and then in fair water, yet in regard we were to determine the pigment we employed, not by bulk, but weight; and because, also, that the yellow colour of the gold is but a faint one in comparison of the deep colour of cochineal, we rather chose this to make our trials with. But among divers of these, it will suffice to set down one, which was carefully

made in vessels conveniently shaped, (and that in the presence of a witness or assistant,) the sum whereof I find among my adversaria, registered in the following words: To which I shall only premise, to lessen the wonder of so strange a diffusion of the pigment, that cochineal will be better dissolved, and have its colour far more heightened, by spirit of urine, than (I say not by common water itself, but) by rectified spirit of wine itself. The note I spoke of is this:—One grain of cochineal dissolved in a pretty quantity of spirit of urine, and then dissolved farther by degrees in fair water, imparted a discernible, though but a very faint colour, to about six glassfuls of water, each of them containing about forty-three ounces and a half, which amounts to above a hundred and twenty-five times its own weight.”

N.B. A few other trials on cochineal are set down in the 32d and 44th experiments; but as they were almost the same with these, I thought it needless to transcribe them.

Mr. Boyle has treated of cochineal not only here, but promiscuously with other things in several experiments, viz. 32d and 44th. But as his tentamina are often occasional, and sometimes only in order to shew the great variety of phænomena and changes in the juices and tinctures of vegetables, and other drugs, by alkalizate or acid salts, I thought it would best agree with my design to render those useful hints and speculative trials practicable, to bring all that to me appeared likely to be serviceable under one article, that the reader might not have the trouble of turning over many leaves for what could be brought into a narrower compass; I shall, therefore, set down the improvements upon the several experiments in the same order as I have from time to time made them, without regard to the course of the experiments themselves.

This little insect, called cochineal, abounds with so much colour, that (as the learned author truly

observes) there are but few things in the animal, vegetable, or mineral kingdoms, whose tincture can be so extensively diffused; but then it is as certain, that there is scarce any tincture more difficultly made permanent, than this of cochineal. Spirit of urine, or any other alkalizate spirit, or lixivial salt, does indeed most powerfully draw out and exalt the colour, but it does at the same time act so violently, that in a very short time the colour will, from a very deep crimson, be thereby changed into a dirty brown, inclining to yellow; though Mr. Boyle, in his thirty-second experiment, assures us, that, by all his trials, he could not make the tincture of cochineal incline to a yellow.

This extraordinary operation of the urinous spirits, &c. plainly shewed me that they were not proper to be employed to make a tincture of cochineal, unless for curiosity's sake, and accordingly put me upon trying in what kind of menstruum the tincture could be made most durable. I found that spirits of wine produced an exquisite bright colour, inclining pretty much to the scarlet, particularly when the spirit had first been acidulated with a few drops of single aquafortis; but when I tried to write, or draw lines therewith on paper, I perceived, that, by its spreading or flowing, it would be unfit for such a use, the letters and lines appearing very rough and ragged, which could not be prevented by gum, nor any other method; so that the only use I found it would be proper for, was to make a transparent spirit varnish, where it makes a very beautiful colour. Nevertheless the fine colour of the tincture tempted me to try to make a scarlet lake thereof, by a precipitation either with an acid or an alkali; and, accordingly, to some of the tincture I added some lixivium of pot-ashes; but this had no other effect than to incorporate therewith, and turn the colour on the purple hue; I then added to some more of the same tincture a quantity of alum-water, expecting thereby to see the colour struck

down; but, instead of that, the alum was precipitated by the spirit alone, in a white powder, and the colour left suspended in the liquor. These trials convinced me that a tincture made with spirit of wine was no farther useful than before mentioned, and obliged me to think of other methods.

After several experiments, all which it will be needless to take notice of, as they varied only in a few inconsiderable particulars, two of them only succeeded according to my wish, the processes whereof is as follows:—

The most lasting tincture that can be made to be useful, is thus performed:—Boil two ounces of rhenish (or, for want of that, half an ounce of cream of) tartar, powdered, in a pint of soft water, about an hour; after which, when it is cold and settled, decant off the water, and mix with it an equal quantity of alum-water, adding ten or twelve drops of single aqua-fortis. Into this mixture put two drachms of the best cochineal, powdered; let it infuse near five hours by a gentle heat, or in the warm sun; and after that, first strain it through a linen cloth, pressing all the liquor from the fæces, and then filter it through paper, when you will have a fine deep scarlet tincture, which may be mixed with gum-water, or a decoction of shreds of leather, will serve for writing and colouring, and may be, by the addition of a little rose-water, preserved a long time without growing motthy, and from decay, being kept close stopped.

Another rich tincture can also be made by boiling or infusing the cochineal in alum-water alone, which will be as durable as the former, and may do very well for some intentions; but as it is nothing of a scarlet, but a bright crimson colour, I thought it sufficient slightly to mention it, and chiefly as the next following process for making a good lake is for the most part upon the same basis.

All the methods that I have read for making a red lake, are either fallacious or good for little: for as

they are principally made from cochineal, or rather shreds of scarlet cloths or stuffs, boiled in a lixivium of pot-ashes, and precipitated with alum-water, the lake can never be but of a purplish hue, and that not quite so beautiful as it should be, because the activity of alkalizate salt does somewhat impair the colour of the cochineal before the precipitation is performed; and that made from the shreds is so weak, unless extracted with exceeding strong lixivium, that the lake cannot have half body enough to satisfy the limners.

Therefore, after repeated trials, I thought the two subsequent methods were not unworthy to be recommended as preferable to those above taken notice of.

The first is made by infusing a drachm of fine powdered cochineal into a pint of alum-water, placing it near a gentle fire to boil softly about four or five hours; then let it grow cold and settle; after which, pour it off from the subsiding fæces into a clean vessel: On the fæces I put another half-pint of alum-water, and boiled it as before, about half an hour, to draw out all the colour of the cochineal; this I strained through a cloth, pressing all the tincture out of the powder, and added to it the other tincture, and filtered altogether through a paper, into a clean phial: then I made a solution of an ounce of salt of tartar in a quart of water, and after having filtered that too, added it to the tincture of cochineal, in a large, clean, glazed pan, or a glass, that the ebullition may not go over the edge of the vessel. After the effervescence is over, the red powder will subside, from which the liquor was gently poured off; and if that still retained a deepish colour, some more of the solution of salt of tartar was put thereto, that all the colour might be precipitated, and the almost colourless water poured off; after that, a large quantity of distilled, or other water, was put on the powder, to be washed therewith till it came off as insipid as it was poured on, observing always to let the colour settle well before the water was decanted from it: this done,

I dried the powder by spreading it on tiles, as before mentioned in making the green, and I had the satisfaction of obtaining a fine lake, nothing inferior to the Florentine, which might have been made up into little grains, in the manner lakes are met with in the shops. Though I would rather advise the maker to keep this, and all other colours, in the powder, because, to make them up in these little grains, they must be ground up with starch, or other matter, to make them stick together, whereby the body of the colours is not only weakened, but likewise makes them apt to grow fat, and unwilling to dry, as is experienced by those that use them in oil. But as I perceived that this, like the Florentine lake, inclined a little too much towards the purple, against which quality the limners might exclaim, I employed my thoughts to find out one that should not be liable to that objection, and for that purpose made trials on many of the vegetables that yield red tinctures; many of these I found to be, either not at all durable in air, or subject to change on the approach of saline and sulphureous qualities, or naturally very nearly border on the purple. Of all the drugs I tried, kermes-berries and madder best answered my desires; but as the first are scarce and dear, I confined myself to the latter, which is cheaper and easier to be had. Of this I made a tincture, by infusing two ounces of the best crap in a pint of alum-water, near a gentle fire, about the space of two hours, and then, after having let it settle about twenty-four hours, I filtered it through a paper. Of this tincture alone a scarlet lake was made, by precipitating the tincture with a lixivium of salt of tartar, and afterwards washed and dried as before directed. But as I did not think this lake from the madder, *per se*, beautiful enough, I mixed the tincture of madder with about a fourth of its quantity of the above-mentioned tincture of cochineal, and then precipitated it as before, which produced a much finer lake. Yet this must be ob-

served, that, as all madder does not give an equal quantity of colour, it will be necessary to make a few trials before you proceed to make the lake. The kermes-berries do likewise make a fine scarlet tincture, by boiling an ounce of them in about a pint of roch-alum-water, adding a few drops of oil of sulphur.

N.B. By putting a little sal martis, or a piece of steel, into the tincture of cochineal, it will be changed into a lovely purple; which is not only directly contrary to the operation of all other acid or metallic salts, whereby the tincture of cochineal is usually turned towards a yellow; but it is even more than can be effected by any alkali that I know of.

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## EXPERIMENT XXVI.

“AND (first) I thought fit to try the operation of the acid salts upon vegetable substances, that are already, and by their own nature, red. And, accordingly, I made trial upon syrup of clove July-flowers, the clear expressed juice of the succulent berries of spina cervina, or buckthorn (which I had long kept by me for the sake of its deep colour), upon red roses, infusion of brazil, and divers other vegetable substances, on some of which, crushed (as is often mentioned) upon white paper, which is also to be understood in most of these experiments, if no circumstances of them can argue otherwise; spirit of salt either made no considerable change, or altered the colour but from darker to a lighter red. How it will succeed in many other vegetable juices and infusions of the same colour, I have at present so few at hand, that I must leave you to find it out yourself. But as for the operation of other sorts of salts upon these red substances, I found it not very uniform, some red or

reddish infusions, as of roses, being turned thereby into a dirty colour, but yet inclining to green. Nor was the syrup of clove July-flowers turned by the solution of pot-ashes to a much better colour. Another sort of red infusion was by an alkali, not turned into a green, but advanced into a crimson, as I shall have occasion to note ere long. But there were other sorts, as particularly the lovely-coloured juice of buckthorn berries, that readily passed into a lovely green."

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### EXPERIMENT XXIX.

"IT may be of some use towards the discovery of the nature of these changes, which the alimantal juice receives in some vegetable, according to the different degrees of their maturity, and according to the different kinds of plants of the same denomination, to observe what operation acid, urinous, and alkalizate salts, will have upon the juices of the several sorts of the vegetable substances I have been mentioning. To declare my meaning, by an example, I took, from the same cluster, one blackberry full ripe, and another that had not yet gone beyond a redness, and rubbing a piece of white paper with the former, I observed that the juice adhering to it was of a dark reddish colour, full of little black specks, and that this juice, by a drop of strong lixivium, was immediately turned into a greenish colour, deep enough; by as much urinous spirit, into a colour much of kin to the former, though somewhat differing, and fainter; and by a drop of spirit of salt, into a fine and lightsome red: whereas, the red berry being in like manner rubbed upon paper, left on it a red colour, which was very little altered by the acid spirit newly named, and by the urinous and lixivate salts received changes of colours, differing from those that had been

just before produced in the dark juice of the ripe blackberry. I remember, also, that though the infusion of damask roses would as well, though not so much as that of red, be heightened by acid spirits to an intense degree of redness, and by lixiviate salts, be brought to a darkish green, yet having for trial sake taken a rose, whose leaves, which were large and numerous, like those of a Province rose, were a perfectly yellow, though, in a solution of salt of tartar, they afforded a green bluish tincture, yet I did not by an acid liquor obtain a red one; all that the saline spirit I employed performed, being to dilute somewhat the yellowness of the leaves. I would also have tried the tincture of yellow violets, but could procure none. And if I were in those islands of Banda, which are made famous as well as rich, by being the almost only place where cloves will prosper, I should think it worth my curiosity to try what operation the three different kinds of salts, I have so often mentioned, would have upon the juice of this spice (expressed at the several seasons of it), as it grows upon the tree. Since good authors inform us (of what is remarkable) that these, whether fruits or rudiments of fruits, are at first white, afterwards green, and then reddish, before they are beaten off the tree, after which, being dried before they are put up, they grow blackish, as we see them. And one of our late herbalists informs us, that the flower grows upon the top of the clove itself, consisting of four small leaves, like a cherry-blossom, but of an excellent blue. But to return to our own observations, I shall add, that I the rather choose to mention to you an example drawn from roses, because that though I am apt to think, as I elsewhere advertise, that something may be guessed at about some of the qualities of the juices of vegetables, by the resemblance or disparity that we meet with in the changes made of their colours, by the operation of the same kinds of salts; yet that those conjectures

should be very warily made, may appear among other things, by the instance I have chosen to give in roses. For though (as I formerly told you) the dried leaves, both of the damask and of the red ones, give a red tincture to water sharpened with acid salts, yet the one sort of leaves is known to have a purgative faculty, and the other are often, and divers ways, employed for binding.

“ And I also choose to subjoin this twenty-ninth experiment to those that precede it, about the change of the colours of vegetables by salts, for these two reasons:—The first, that you may not easily entertain suspicions, if, in the trials of an experiment of some of the kinds formerly mentioned, you should meet with an event something differing from what my relations may have made you expect. And the second, that you may hereby be invited to discern, that it may not be amiss to take notice of the particular seasons wherein you gather the vegetables, which in nicer experiments you make use of. For if it were not hindered both by haste and some justifiable considerations, I could perhaps add considerable instances to those lately delivered, for the making out of this observation; but for certain reasons I shall at present substitute a remarkable passage to be met with in that laborious herbalist Mr. Parkinson, where, treating of the virtues of the already divers time mentioned buckthorn-berries, he subjoins the following account of several pigments that are made of them, not only according to the several ways of handling them, but according to the different seasons of maturity at which they are gathered: And I remember that I tried, with a success that pleased me well enough, to make such a kind of pigment, as painters usually call sap-green, by a way not unlike that delivered here by our author, but I cannot find any thing relating to that matter among my loose papers. And my trials were made so many years ago, that I dare not trust my memory

for circumstances; but I will rather tell you, that in a noted colour-shop I brought them, by questions, to confess to me, that they made their sap-green much after the ways by our botanist here mentioned. And on this occasion I shall add an observation which, though it does not strictly belong to this place, may well enough be mentioned here; namely, that I find, by an account given us by the learned Clusius of Alaternus that even the grosser parts of the same plant are some of them one colour, and some another; for speaking of that plant, he tells us, that the Portuguese use the bark to dye their nets into a red colour, and with the chips of the wood, which are whitish, they dye a blackish blue."

The trials that come next to be taken notice of, are but a part of these experiments (the rest being of no use to my present design), yet I hope what I have set down relating thereto, will be serviceable. In my search for a good green, I tried, amongst other things, what this juice of buckthorn-berries would do; but I soon perceived that not much could be effected therewith, for when I had inspissated it to a thick extract, with the greatest caution to prevent its burning, it yielded but a very bad dirty green: Besides that, the tincture of the juice is so faint, that it required a great deal of trouble and expense to inspissate a quantity of juice sufficient to make proper trials upon; both which, as well as the change that the acids made in the colour, discouraged me from attempting any thing further with it. I had, however, recourse to a pigment, said to be made of this juice, called in the shops by the name of sap-green, which was not only ready prepared to my hand, but promised something considerable to be performed by it. There are two sorts of this sap-green sold; the one English, the other French. The first does not so readily dissolve in water as the latter, and inclines much more to the yellow; therefore I chose to make use of the last. To make a green tincture of any de-

gree of strength, far exceeding the juice of the buckthorn, there needs no more trouble than to dissolve it in fair cold water, in which it will serve for colouring maps, prints, &c. without the addition of any gum: and if a little vinegar is put into the water, it will turn it more green; but it must be observed, that it will require to be made fresh as often as the colour appears to decay, or turn yellowish. To make this tincture of a more pleasant green, some fine powder of distilled verdigrise may be added at pleasure; only giving it a proper time to dissolve and incorporate therewith, whereby the colour may be varied, more yellow or green, and deeper or paler, as occasion shall make it necessary. I must also put you in mind, that, with or without the verdigrise, the tincture should be filtered through paper before it is used.

The second use that is to be made of this sap-green, is to procure from it a fine lemon-yellow tincture, that will answer the end of the green-gathered buckthorn-berries, which Mr. Parkinson says are used for that purpose. To do this, take twenty-four grains of the sap, dissolve it (finely powdered) with an equal quantity of salt of tartar, in four ounces of warm water, and in three or four hours' time you will have a beautiful colour, which must likewise be filtered, and will be fit for any of the above-mentioned uses.

This last process should more properly have been inserted where I treat of the experiments relating to yellow pigments, but as it was on the basis of the sap-green, I thought it would not come in amiss here, it being the subject of these experiments. There may also be made of this drug, a fine red tincture, that will serve instead of some of the reds before spoken of; and this is done only by dissolving it in water, acidulated with a few drops of single aquafortis; but of this red tincture no red powder or lake can be made; for upon precipitation, which must be performed by an alkali, the powder will be of a greenish yellow colour: nor can there be a green powder

made of it, because it can be dissolved in no acid or saline menstruum, except vinegar, to make a green tincture, and then, whatever it is precipitated with will turn it a yellow. I should now proceed to the forty-ninth experiment, but I will first say something relating to Mr. Boyle's quotation from Parkinson, concerning the buckthorn-berries and sap-green, in the latter part of the twenty-ninth experiment.

Mr. Parkinson says, "That of these berries are made three several sorts of colours, as they shall be gathered, that is, being gathered while they are green, and kept dry, they are called sap-berries; which being steeped or fresh bruised into some alum-water, they give a reasonable fair yellow colour, which painters use for their work, book-binders to colour the edges of books, and leather-dressers to colour leather; as they use also to make a green colour, called sap-green, taken from the berries when they are black, being bruised and put into a brass or copper kettle or pan, and there suffered to abide three or four days, or a little heated upon the fire, and some beaten alum put into them, and afterwards pressed forth, the juice or liquor is usually put in great bladders, tied with strong thread at the head, and hung up till it be dry; which is dissolved in water, or wine, or sack, which last he affirms is the best to preserve the colour from starving or decaying, and make it hold fresh the longer. The third colour is a purplish, made from the berries, suffered to grow upon the bushes till the middle or end of November, when they are ready to drop from the trees."

The truth of this account I cannot contradict, having never had opportunity nor leisure to try the berries of these different degrees of maturity; but will beg leave to observe, on the first part thereof, that the yellow colour used by painters (called in the shops Dutch pink), and the tincture wherewith, I think, book-binders generally colour their leaves, and leather-dressers their leather, is made of French

berries of Avignon, that grow on the box-thorn, and are called sap-berries, as may be seen in Pomet's History of Drugs, page 21, which berries differ in all respects from those of the spina cervina, or buck-thorn.

The second part of the account concerning the sap-green is confirmed, as well by Mr. Boyle, in the same twenty-ninth experiment, as by Pomet's History of Drugs, Book IX. page 223, in the article of Roucou. But, nevertheless, I think there is some reason to doubt whether all, or the best, sap-green is made of the buckthorn-berries; for, besides what I have before hinted about inspissating the juice, I could never find that alum would change the tincture of sap-green red, as Mr. Boyle asserts of this juice, but to a bright yellow, as appears from the before-mentioned fine lemon-coloured tincture. Possibly the English sap is made of the buckthorn-juice, according to Mr. Parkinson's relation, because I always found that to have less body, more yellow, and harder to dissolve, than the French. To this might be added, that, if the sap-green is made of the juice of buckthorn-berries, it is something of a wonder it has not yet been introduced into physic, as a cathartic (having been known long enough), instead of the juice, which can be had but once a year, and requires so much trouble and room to preserve it all the year; when the sap may be had always, and is dissolved in a few minutes, if the quantity for a dose is once fixed. Wherefore I should rather imagine the sap-green to be made from young leeks (as the Greek name *prasinon*, and Latin *prasinus* or *porraceus*, imports), or from some other plant that abounds with a more deep-tinctured green juice, than that of the buckthorn-berries. But, as this is my private notion, which I have not had experience enough to be assured of, I will submit to the authority of these two gentlemen, that have obliged the world with such excellent works. What is contained in the third

part I know nothing of, there being at present no purple-colour to be met with in the shops, besides turnsole; which, according to Mr. Parkinson's account, quoted by Mr. Boyle in his thirty-sixth experiment of this essay, is made of another berry: so shall leave this subject, and go on to my trials on experiment forty-nine.

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### EXPERIMENT XLIX.

“MEETING the other day, in an Italian book, that treats of other matters, with a way of preparing what the author calls a *lacca* of vegetables, by which the Italians mean a kind of extract fit for painting, like that rich *lacca* in English, commonly called lake, which is employed by painters as a glorious red: and finding the experiment not to be inconsiderable, and very defectively set down, it will not be amiss to acquaint you with what some trials have informed us, in reference to this experiment; which, both by our Italian author, and by divers of his countrymen, is looked upon as no trifling secret.

“Take then the root called in Latin *curcuma*, and in English turmerick, which I made use of because it was then at hand, and is, among vegetables, fit for that purpose, one of the easiest to be had; and when it is beaten, put what quantity of it you please into fair water, adding to every pound of water about a spoonful, or better, of as strong a *lixivium* or solution of pot-ashes as you can well make, clarifying it by filtration before you put it to the decocting water. Let these things boil, or rather simmer, over a slow fire, in a clean glazed earthen vessel, till you find, by the immersion of a sheet of white paper (or by some other way of trial) that the liquor is sufficiently impregnated with the golden tincture of the turmerick;

then take the decoction off the fire, and filter or strain it, that it may be clean, and leisurely dropping into a strong solution of roche-alum, you shall find the decoction, as it were, curdled, and the tintured part of it either to emerge, to subside, or to swim up and down like little yellow flakes: and, if you pour the mixture into a funnel lined with cap-paper, the liquor that filtered formerly so yellow, will now pass clean through the filter, leaving its tincture, and as it were curdled part, in the filter, upon which fair water must be so often poured, till you have dulcified the matter therein contained; the sign of which dulcification is, when the water that has passed through it, comes from it as tasteless as it was when poured on it. And if, without filtration, you would gather together the flakes of this vegetable lake, you must pour a great quantity of water upon the decoction, after the affusion of the aluminous solution, and you shall find the liquor to grow clearer, and the lake to settle together at the bottom, or emerge to the top of the water, though sometimes having not poured out a sufficient quantity of fair water, we have observed the lake partly to subside, and partly to emerge, leaving all the middle of the liquor clear. But to make this liquor fit for use, it must, by repeated affusions of fresh water, be dulcified from the adhering salts, as well as that separated by filtration, and be spread and suffered to dry leisurely upon pieces of cloth, with brown paper, or chalk or bricks, under them, to imbibe the moisture."

In the margin of this experiment, the author refers the curious reader for farther information to the seventh book of Neri's Art of Glass, englished and illustrated with learned observations, by the inquisitive and learned Dr. Charles Merret: but, as I have not that book by me at present, I cannot oblige the reader with a transcript from it; therefore, must content myself with setting down what I have experienced from that book, and to recommend those who

are desirous to know something of Neri's method, to the first nine chapters of Blancourt's *Art of Glass*, which, as near as I can remember, contain what is taught by Neri.

The four annotations subjoined to this experiment, I shall not need to transcribe, as they are only remarks on the foregoing, concerning the different effects of the several kinds of salts upon the tinctures of vegetables and other drugs. I shall, therefore, only take a cursory notice of such parts thereof as any ways relate to my design.

Part of this experiment, and the annotations thereon, treating of the method of producing lakes (as they are called) of all colours from vegetables, according to the doctrine of Ant. Neri, whose experiments the author praises, I shall first take the liberty (supposing Mr. Boyle not to have tried them all) to mention, wherein I think Neri has left to posterity, a wrong account, and where my learned author has too much credited him; and then proceed to communicate what has occurred to me upon trial, particularly concerning yellow tinctures and pigments, having already spoke of the other colours.

I have, in my notes on some of the foregoing experiments, taken notice, that the way of making green and blue lakes from plants is altogether useless, if not impracticable, so that I shall only, in a few words, now shew, that if Mr. Boyle had but reflected on what he himself said in the annotation, "that lixivate salts, though by piercing and opening the bodies of vegetables they pare and dispose them to part readily with their tinctures; yet some tinctures not only draw out, but likewise alter them, as might be easily made appear (says he) by many experiments set down in the same treatise," he certainly would not have spoke in such general terms to favour Neri's pretence to make magisteries or lakes from rue, and other the like plants, that could be useful and acceptable to artists. It is true, that in the latter part of the third

annotation on this forty-ninth experiment, he does declare some diffidence in the matter; but yet, in my humble opinion, he lays too much stress on the authority of Neri and Dr. Merret's observation; for though I will allow that green and blue lakes, or magisteries, may be made from some deep-tinctured juices of plants, yet am, at the same time, certain that they must change their colours in oil. But, as I believe most of Neri's disciples, as well as myself, have, at their own expense and trouble, too often experienced the insufficiency of his laborious processes, I shall leave this subject, and go on with what I can affirm, from my own practice, to be fact and practicable.

I have already, under the article of sap-green, shewn the way to make a fine lemon-coloured tincture from that pigment, so need only mention here, that from that tincture a beautiful lake of the same colour is to be made, that is durable as well as useful, by precipitating that tincture with a sufficient proportion of alum-water; and, afterwards washing off the salts, and drying, as directed in former processes.

The second yellow pigment (called Dutch pink) is made, as before hinted, of the French berries of Avignon (used also by the calico-printers), by infusing twenty-four grains of them in about three ounces of alum-water, and after they have been boiled over or near a slow fire, an excellent yellow tincture will be procured, which (being filtered, will serve for colouring maps, &c.) must be precipitated with lixivium of pot-ashes, and washed to sweetness, as formerly directed; but, if the precipitation is performed with a lixivium of salt of tartar, the colour will be much the better for it, and beyond any thing that is sold under the name of brown or yellow pink, for beauty, body, and transparency, provided it is not afterwards ground up with cuttle-bone, or some other material, for lucre's sake, by which means many good colours are spoiled, such like things mak-

ing them grow fat (as the colour-men term it), and are long in drying, which is a very bad quality.

The yellow made from the turmeric, mentioned by Mr. Boyle in this experiment, is not so good in a tincture as saffron, and the magistery made from it is not lasting in oil, the sun soon drawing it all away, as I have more than once tried: but, as a lake in water-colours, it may be of some service.

Another yellow tincture, that is no less useful in washing and colouring maps and prints, can be made from gamboge. I know this drug is already used in the water-colour way, but it is only by dissolving it in water, which way I disapprove, and would by no means recommend, because of its hurtful quality, and therefore offer this as more eligible, useful, and, on all accounts, better.

Take an equal quantity of gamboge and salt of tartar, powder them together, and dissolve in a due proportion of boiling water, so as to make a deep tincture. When perfectly dissolved, let it be filtered through paper, and put into a clean phial for use. If it should not be glutinous of itself, and be apt to sink or spread, a little thick gum-water may be added. This tincture can be made to any degree of deepness, according to the quantity of water that shall be employed. The proportion that I found to make a good tincture, was twenty-four grains of each ingredient in half a pound of water. It will serve all the intentions of the common way, and as the salt of tartar does in a great measure correct the acrimony of the gamboge, it must be less attended with the bad effects that are often occasioned by putting the pencil into the mouth. Another tincture, though not a transparent one, may be made of this drug, with spirit of wine and water; but, as I have before observed, that tinctures made with a vinous spirit are not very useful, did not think it needful to set down the process. There can likewise be made from the first of these tinctures a magistery; but it cannot be used in

oil, and differs so little from the inspissated juice itself, that it is not worth making.

There are many other vegetables, besides the last, (of which Mr. Boyle takes no notice,) from which yellow colours can be procured, the tinctures and seeds of most plants having a natural tendency that way; but few of them are fine and lasting, which, therefore, I shall forbear to set down, to prevent expense and trouble: yet there is one that I must not pass over, and that is the plant called *woold* or *weld* in English, and *luteola* in Latin, well known to our dyers for its excellent use in dying yellow, as any body may be farther informed by having recourse to the ingenious Mr. Miller's Gardener's Dictionary. If this is treated in the manner as directed about the French berries, both a fine durable tincture and a lake is made.

Thus much for yellow: I will now only add two colours more, that, because of their affinity to the last, ought to be placed under this head.

The first is a pigment, known in the colour-shops by the name of *anotto*, and is of a deep gold-colour, inclining to red. Twelve grains of this, dissolved with four-and-twenty grains of salt of tartar in four ounces of water, makes a noble rich tincture, which, when filtered, with the addition of a little gum-water, is useful in all cases where a tincture is required. Of this tincture may also be made a very strong-bodied lake, in the same manner as other magisteries, which, though not to be recommended for painting in oil, because it almost all flies off in a short time, especially in the sun; yet may be of service in the miniature and and fan painting way, to heighten other colours, and, if rightly managed, will do the office of gallstone, the colour of which it nearly resembles.

This, I think, is the drug which the French call *roucou*, and the Dutch *orlean*; and is said to be an ingredient in that precious colour, *carmine*; though I very much doubt of the truth of the assertion, not only because the *roucou* would shew itself as soon

as the carmine is put into water (for that fine colour is not made by precipitation, as other lakes or powders are), but because I have some reason to believe, that almost the whole process of the carmine is given wrong by all authors that treat thereof, there being one ingredient in it, which is easily separated from it, and is very different from any that are mentioned to be in the composition of that colour, as I shall take an opportunity, some time or other, when I have leisure, to make further trials thereon, to acquaint the world with.

As to the roucou, or anotto itself, those that are curious to know farther about its culture and manufacture, may be satisfied by consulting Mons. Pomet's *History of Drugs*, at the latter end of Book IX.

The other drug I am to speak of, is Japan earth. Of this a tincture is made by dissolving in water only; but if a small proportion of alkalizate salt be dissolved first in the water, it will do sooner. This may be used instead of tincture of soot, which is very disagreeable, as many other colours at present in use are, in the room of which I would recommend these contained in this treatise, as more elegant and more pleasant.

Of the tincture made with the salt, a bright brown powder is made by precipitating it with an acid, or alum-water, and afterwards managed by several abluions, and drying, as in former processes.

What this is the juice of, is as yet uncertain, for that it is the juice of a plant, though it still retains the improper name of earth, is, I believe, by every body allowed; yet I am inclined to surmise, from some experiments I have made, that it is the concentrated or inspissated juice of tea, particularly of Bohea tea, which I have found to yield a tincture so much like the other, both in colour and taste, that I could not discern any difference. I have not, indeed, tried them in a medicinal way (that being out of my province); but as the Japan earth is a little austere on the tongue, and leaves a sweet flavour in the throat, so does the

tea, and therefore I am apt to believe them originally the same: and, according to the description given of both in the dispensatories, they agree in being astringent and balsamic. To conclude, I believe that, if a proper extract was made of the tea, so as to answer the strength of the Japan earth, it would in effect appear to be the same thing; but the trial hereof I will leave those gentlemen to whom it more properly belongs, and content myself with giving the hint.

Thus far I have communicated what has fallen in my way, in my working on Mr. Boyle's experiments, and others of my own, thinking some of them might be profitable to those that either do or are desirous to prepare colours for the limners, and other artists: I shall only subjoin a particular use that may be made of the before-going tinctures, which is to stain or dye paper of all colours, and then conclude this little tract, with adding the process for making the Prussian blue; not for the sake of making that colour, which I believe is already sufficiently known, but to teach a way to make two or three other colours on that basis, with a little variation and addition, which has not hitherto been done by any body else, that I know of.

The first thing, then, that I purpose to do, is to shew in what manner paper may be dyed with the before-mentioned tinctures. To do this well, it is necessary to observe, that the paper must be without stiffening, or alum, as the filtering paper is prepared. Secondly, there must be an earthen, stone, or wooden, shallow trough, a little larger than a sheet of paper, made to contain the tinctures: And, thirdly, the paper must be dipt in the tincture, which will soon soak through: and, when hung across a line to drain and dry, will be of an even colour. After it is dry, the paper may be stiffened and glazed fit for fans, and other uses; or it may be used as it is, according to what it is intended for.

N.B. Besides this way of staining paper, it can likewise be performed by the juices of flowers, fruits,

and plants, when they are fullest; but this must be done on paper that is already stiffened, as writing-paper is; because the other sort of paper will imbibe the juice too much, and be unpleasant. However, this I leave to the option of the operator.

Now I will proceed to the last thing I intended, viz. to set down the process for making the Prussian blue, in English, because I do not remember to have seen it published any where but in one of the Philosophical Transactions of the Royal Society, No. 381, for the months of January and February, 1724, where it is inserted in Latin; but chiefly because I intend to shew, as I already hinted, what is to be done on the same basis, for making some other different colours, which I believe is not only unknown to the public, but even to the Royal Society itself.

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### THE

### PREPARATION OF THE PRUSSIAN BLUE.

*Sent from Germany to JOHN WOODWARD, M.D.  
Professor of Physic at Gresham College, and Fellow  
of the Royal Society.*

TAKE of crude tartar and crude nitre, of each four ounces; let them be powdered fine, and mixt together; then put them thus mixt in a crucible, into a charcoal fire, till it is detonated or melted, and by this means you will have four ounces of extemporaneous salt of tartar. This salt being yet hot, let it be gently powdered, and add four ounces of ox's blood, well dried and powdered; these being well mixt, put all together into the crucible, and in the fire, till a third part is diminished: then, being covered in the fire, let the crucible be surrounded with fresh charcoal, that it may kindle by degrees, and that the materials may not

flame, boil, and burn too violently. In this manner the materials must remain in the fire, till the flame and boiling ceases. After that, take the crucible from the fire, and pour the matter into an iron mortar, and let it be gently powdered; and have at hand four pounds of hot rain or distilled water, in which put the warm matter, and let it boil for the space of half an hour; being boiled, strain it through a cloth, and pour fresh water on the remaining black matter, which set on the fire to boil, and strain it as before; repeating this so often till the water comes off quite insipid, which will shew that all the saltness and acrimony of the materials is extracted. The residue in the cloth must be well pressed out; after which, all the liquor must be put into one vessel, and again set on the fire, till there remains but four pounds, which may be set by for use; mark it No. 1.

Then take of English vitriol, calcined to whiteness, one ounce, dissolve it in six ounces of rain-water; and, when filtered through paper, mark it No. 2.

Lastly, Take eight ounces of crude alum, and dissolve it in four pounds of warm water, till all is melted. This being rightly performed, join to it the solution of vitriol, No. 2, and heat them on the fire in a large pot; to which pour the lixivium No. 1, after it has likewise been separately heated, whereupon a strong ebullition will ensue, and there will appear the colour of mountain-green, or borax (commonly called chrisocolla): during this ebullition, pour it several times out of one vessel into another, and when it ceases, set it by to settle. When it is well settled, pour it into a fine linen filter, that all the water may drain off, and nothing but the colour remain in the cloth. When no more water drops away, with a wooden ladle put it out of the cloth into a smaller vessel; after that, pour upon the colour two or three ounces of spirit of salt, and there will immediately appear a beautiful blue colour; to which, when it has stood a night, must be put a large quantity of clear rain or

distilled water, stirring it well with the ladle; and when it is again settled, the water must be gently poured off, and fresh water put on so often, till the water that is decanted is entirely sweet and insipid; when the colour must be again put into a linen filter, and after all the water is drained off, it may be spread on the cloth, and dried by a gentle warmth, fit for use.

N.B. Upon the calcination, the success of the process wholly depends; for the light or dark blue, and all diversity of colour, proceeds from the slight, middling, or strong, calcination of the blood with the salt of tartar.

The warm liquors must be added together at once, in the speediest manner that can be.

Now, as from the above process, with some small variations, three other good and useful colours can be made, I suppose it needless to give the whole course of each of them, and therefore shall only mention the particulars wherein they differ.

To make the green, you must put sixteen penny-weights of bruised French berries of Avignon into a pound of the solution made with vitriol and alum, which must be gently boiled, after it has stood a day to make a deep yellow tincture, then it must be strained and added to an equal quantity of the lixivium with blood, as is directed in making the blue; thus you will have a good deep green powder, which must be also well washed and dried for use, and makes a good colour in oil.

The purple is made by boiling an ounce of powdered cochineal in twenty ounces of the solution of vitriol and alum, and added to twenty ounces of the lixivium with blood, proceeding in all other respects as in making the Prussian blue, except the addition of the spirit of salt, which must not be used for this; nor is it very necessary in the green, unless it should be imagined that the colour can be thereby amended.

The yellow is made without the blood; that is, by the solution of vitriol and alum, with an equal pro-

portion of a lixivium made with the detonated tartar and nitre only; but the operation must be performed whilst the liquors are fresh. This last colour is also of good use in oil, but will not glaze.

To these things I might add the processes of two beautiful and lasting greens, the one for limners, and the other for common use, instead of verdigrise; and likewise a fine beautiful scarlet lake; but as they cost me a great deal of labour and expense, I cannot condescend as yet to part with them to the world, at so easy a rate as the profit of such a small treatise as this can import; so shall conclude with only saying, that I hope some people will find it worth the while to introduce these colours into use, which I have not leisure to do, to prevent the mischiefs that many artists, as well as others, that are constantly conversant with the poisons now made, labour under, which alone will be sufficient to make me think my time, for bringing these few experiments together, well spent.

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## ADDITIONAL OBSERVATIONS.

1. SEVERAL of the pigments from which the foregoing tinctures are made, may also be used for liquid colours, by infusing them either in limpid water, without the help of any kind of salts, or in rose-water, in which the colour will continue longest without growing mothery; and by tempering these tinctures with thick gum-water, which way will rather be more agreeable and elegant for gentlemen and ladies, who love to divert themselves with colouring prints and drawings, or painting on silk.

2. Although I have hinted that tinctures made with spirit of wine are of no use for the purposes mentioned above, yet there are several drugs that yield deep tinctures in that menstruum; such as



