

è linteo in ollam novam minorem remove; superfunde postea spiritus salis comm.  $\text{ʒii}$ . vel  $\text{ʒiii}$ . & statim apparebit color cæruleus pulcherrimus: quæ probe mixta per noctem quiescant, quo factò aquæ pluvialis magna quantitas addatur, in gyrum moveatur spatula, & posteaquam refedit materia, aqua decantetur, & recens aqua superfundatur, & eodèque labor reiteretur, donec omnis acrimonia sit desumpta, & aqua insipida defluat; hoc factò præcipitatum tuum summè cæruleum linteò expansoingere, ut aqua distillet, sensimq; color calore leni exsiccet usui.

*N. B.* Calcinationo magni momenti est in hoc opere, nam color cyaneus & cæruleus obscurus ortum suum trahit a calcinatione levi, mediocri, & forti sanguinis arefacti cum sale Tartari, & inde diversitas coloris.

Lixivia ferventissima uno eodemque festinatissimo actu sunt confundenda.

*V. Observations and Experiments upon the foregoing Preparation. By Mr. John Brown, Chymist, F. R. S.*

**D**R. *Woodward* having lately communicated a Paper (which he receiv'd from another hand) to this Society, containing a Process for making the *Prussian Blue*. I was willing to go thro' it exactly, according to the Proportions there prescrib'd; and observ'd that by a Calcination of  $\text{ʒ4}$  of Blood dry'd, with  $\text{ʒ4}$  of *Sal Tartari*, in two Hours time that Part of the Operation was over, and a black spongy Substance remain'd in the Crucible weighing  $\text{ʒ4}$ . a Dissolution of which being made in boiling Water and afterwards filtred, the Remainder, when dried, weigh'd

VOL. XXXIII.

D

9 Drachms,

9 Drachms, *Avoirdup.* the former having been weigh'd by the same kind of Weight.

The Loss in the Dissolution and Filtration of the Vitriol and Alum, is not worth taking Notice of, they having both been very clean before they were dissolv'd. The Mixtures being made as prescrib'd, with the Addition of the *Spiritus Salis*, the Product was a very fine Blue, which when welledulcorated by frequent Washings, and after that thoroughly dried weigh'd ʒi. or a little more, and entirely answer'd the Character the Author gave of it.

Among the several Experiments that were made with these Liquors, I mean the *Lixivium* with Blood, the Solution of Vitriol, the Solution of Alum, and the Spirit of Salt, tho' they always produced a Blue, yet that Blue differ'd in Degrees of Colour, according to the varied Proportions of the Vitriol and Alum, and the Colours produc'd from these several Proportions were each of them improv'd by the Addition of the *Sp. Salis*.

I shall mention only two of the several I tried, in one of which the Alum was entirely left out, and a pale Blue produc'd; in the other, the Proportions of Vitriol and Alum were equal, and a very deep Blue was produc'd.

These Differences in Colour, arising from the several Proportions of the Vitriol and Alum, are only mention'd to confirm the Truth of the Author's Prescript, as being the most exact and best proportion'd to produce the finest Colour, of any I have try'd. The only Misfortune he takes notice of, as attending his Prescript, is what may happen in the Calcination.

It would be curious to know what gave the first Hint for the Production of so fine a Colour, from a Combination of such Materials; especially when we come to consider, that the Blood has the greatest and principal  
Share

Share in this surprizing Change. I doubt not but Blood of any kind, or Flesh of any kind, would produce the same Effects, but have reason to believe the latter would not produce so beautiful a Colour as the former. I purposely dry'd some Beef freed from its Skin and Salt, and pursued the same Course as with the Blood; but there was a sensible Difference to be observ'd during the Calcination, and a very manifest one in the Beauty of the two Colours, when finish'd.

To prove the Share the Blood has in this Change, the following Experiments (some of which I had the Honour of shewing before this Society) may be convincing.

The Solution of Alum mix'd with that of the Vitriol produceth no Alteration of Colour: if to these you add the *Spiritus Salis*, the Appearance is the same; but if to the whole you put the *Lixivium* with Blood, there precipitates a Blue.

If you substitute, instead of the *Lixivium* with Blood, a *Lixivium* made with the same Salt of Tartar only, which then becomes an *Ol. Tartari*; and after the Mixture of the Solution of Alum, with that of the Vitriol, you pour on this *Ol. Tartari*, there follows indeed a Precipitation, but of no Colour; and if you add the Spirit of Salt, it so strongly attracts what is precipitated, as to render the muddy Mixture perfectly clear.

The very same Effect will follow, if any Volatile Alcalious Spirit is made use of as a precipitant, or any Volatile Salts dissolv'd in Water; nor can the Blood itself be supposed to communicate this Change from any such Properties, the Heat of Fire it undergoes in the Calcination, being sufficient to throw them off.

In the Calcination of the dry'd Blood and Salt of Tartar it was observ'd, that there was a Loss of just

half. It is difficult to determine exactly what Quantity of either was lost by this Calcination, but it will easily be granted, that there was lost a far larger Quantity of the Blood, than of the Salt of Tartar; and that is obvious from an Experiment, by which, when the Salt of Tartar was calcined by itself, with the same Degree of Heat, it lost less than an  $\frac{1}{2}$  Part, whereas, when the dry'd Blood was calcined by itself, it lost more than  $\frac{1}{2}$ .

The Blood, in Calcination with the Salt of Tartar, communicates its tinging Quality to the Salt, or that Quality is extracted from it by the Salt, and passes with it in its Dissolution in the boiling Water.

To prove this, some dry'd Blood was calcin'd by itself, and a strong Decoction was made of it in Water, and afterwards filtred: this, when mix'd with the former Solutions, produced little or no Alteration; but on the Addition of the *Spiritus Salis*, changed to an Amber Colour, without any Precipitation.

When this Liquor was mix'd with the *Ol. Tartari*, and poured to the former Solutions, it caus'd a Precipitation, but no Colour, and the *Spiritus Salis*, as in the other Experiment, made the Liquor clear again, but left this also of an Amber Colour.

The Change of Colour is not effected in any of the Materials, except in that of the Solution of Vitriol, so that the Alum seems only to be of use in fixing the Colour, as it is often us'd by the *Dyers* for that Purpose, and the *Spiritus Salis* gives it a deeper Dye. For if the *Lixivium* with Blood be poured to the Solution of Alum alone, there will fall a Sediment a little on the Purple, to which if you add the *Spiritus Salis*, it changes the Colour, and the Sediment is of a Brown.

So, much the same changes will be produced, if you pour the *Spiritus Salis* to the *Lixivium*, but not the least Appearance of a Blue, whereas, as is beforemention'd, when

when the *Lixivium* is poured to the Solution of Vitriol, there immediately follows the Blue, which is still heighten'd by the Addition of the *Spiritus Salis*.

It will not be improper to take notice, that as the Author orders all the Liquors, except the *Spiritus Salis*, to be boiling hot when mix'd, so it is certain the Colour is thereby more immediately produc'd, and looks more beautiful; but most of the Experiments here mention'd were made with the Liquors cold, and the Colours came to their Beauty with a little washing. In one of the Experiments with the Liquors cold, after the *Lixivium* with Blood had precipitated the Blue in the Mixture of Alum and Vitriol, by pouring in a little more of the *Lixivium*, the Blue all disappear'd, and an ugly muddy Colour was left; but the Addition of the *Spiritus Salis* soon discharg'd that, and the Blue return'd.

In calcining the Beef and Salt of Tartar, I found the Matter left in the Crucible to weigh just half of the whole Mixture, as in that with the Blood; but after the boiling it in Water, the *Residuum* in the Filtre when dry'd, was very near a third less in Proportion than the other. From whence may be reasonably infer'd, That the Salt of Tartar holds a larger Share of the Beef in the one Operation, than of the Blood in the other.

Having in the former Part of this Account of the *Prussian Blue* prov'd, by the Experiments there mentioned, that the Solution of Vitriol was the only Subject among those Ingredients, that the *Lixivium* of Blood produc'd this Change of Colour in it; and having since consider'd that the Vitriol made use of in this Preparation, is no more than Iron dissolv'd by a Liquor running from the *Pyrites*, when expos'd to the Weather, which is afterwards boil'd up and shot into Crystals,

stals; it seem'd to follow as a natural Consequence, that this Metal is the Subject on which the *Lixivium* of Blood produces the change; and this Thought gave occasion to the following Experiments on metallick Bodies, in order to observe if the same Change of Colour could be produc'd in any of them.

To a Solution of Silver in *Aquafortis* was pour'd the *Lixivium* of Blood, which occasion'd a *Coagulum* of a pure Flesh Colour. The *Lixivium* made with Flesh produc'd a whitish *Coagulum*, and the *Ol. Tartari* (which was continued to be us'd by way of comparison with the other *Lixivia*) a much whiter. By the Addition of the *Spiritus Salis* to each of these, the Bloom of the Flesh Colour was taken off in the first, but suffer'd no other Change. In the second the *Coagulum* was a little ting'd with Blue; and in the third the White was manifestly improv'd. The bluish Tinge in the second of these Experiments cannot entirely be assigned as the Effect of the *Lixivium* with Flesh, because Silver, when thus dissolv'd, whether precipitated with Salt Water, or *Ol. Tartari*, will, after it has stood some Time, contract a bluish Tinge, and this from an Alloy of Copper, from which it is not entirely freed.

The same Liquors were made use of to precipitate the Mercury in the *Mercurius Sublimatus Corr.* dissolv'd in Water; the Consequence of which was, that the *Lixivium* with Blood produced a pure yellow; the *Lixivium* with Flesh an Orange Colour; and the *Ol. Tartari* a dingy red. The addition of the *Spiritus Salis* to these, made some very odd Alterations; for the first chang'd its yellow Colour for an Orange; the second, its Orange for a Blue; and the third became quite clear again without any Colour. The blue Colour in the Mixture of the *Lixivium* with Flesh, and Solution of Sublimate, may be accounted for from the

Vitriol in the Composition of the Sublimate; but it will not be so easy to give a Reason why the same Colour should not have been produced from the *Lixivium* with Blood, and the same Solution.

Copper, when dissolv'd in *Aquafortis*, tinges the Water of a green Colour; and if to this you pour the two *Lixivia* of Blood and Flesh, the *Coagula* are much alike, *viz.* a white ting'd with green; but when you add the *Spiritus Salis*, they both change and become of a Colour not unlike the Copper itself before it is dissolv'd in the *Aquafortis*. If the *Ol. Tartari* be pour'd to a Solution of the Copper, the *Coagulum* is a pale green, which *Coagulum* the *Spiritus Salis* dissolves, and leaves the Liquor clear, but green, as before Precipitation.

Tin-Glass (an imperfect Metal) dissolv'd in *Aquafortis*, and mix'd with the *Lixivium* of Blood made a milky *Coagulum*, and by the Addition of the *Spiritus Salis*, after some Time standing, its upper Surface chang'd to a light Blue. The *Lixivium* of Flesh and the *Ol. Tartari* produc'd both white *Coagula*, which the *Spiritus Salis* scarcely alters.

Lead dissolv'd in Spirit of Vinegar produceth much the same white *Coagulum*, when mix'd either with the *Lixivium* of Blood, Flesh, or the *Ol. Tartari*, nor doth the *Spiritus Salis* make any Alteration.

By all these Experiments it is pretty evident, that not any of these metallick Bodies were affected by the *Lixivium* of Blood, so as to produce this fine Blue. The two Metals untried are Gold and Tin, the latter of which, when dissolv'd in Spirit of Vinegar, has so near a Resemblance to Lead dissolv'd in the same *Menstruum*, that in all Probability the Experiments would answer much alike in both. What may be expected from Gold, I am not yet so well assured of, as I am from Iron, which  
when

when dissolv'd in *Spiritus Vitrioli*, will answer all the Experiments that have been tried with the Solutions of Vitriol, and produce as fine a Colour; nor can this be owing to any Property in the Dissolvent itself, which, tho' drawn from the same kind of Vitriol all along made use in these Experiments, yet is so alter'd by the violent Fire in the Production of it, as not to answer in any Trials to the Vitriol itself.

May we not therefore hence conclude, that Iron is the Metal, that is the Subject of this beautiful Colour produc'd by Means of the *Lixivium* with Blood?

---