

# **The Sixth Book Of Natural Magick**

## The Proeme

From the adulterating of metals, we shall pass to the counterfeiting of jewels. They are by the same reason, both arts of kin, and done by the fire. And it is no fraud, says Pliny, to get gain to live by. And the desire of money has so kindled the firebrand of luxury, that the most cunning artists are sometimes cheated. They are counterfeited by diverse ways, either by cutting jewels in the middle, and putting in the colors, and joining them together. Or else by giving a tincture to Crystal that is all one piece, or counterfeiting Crystal by many ingredients, or we shall attempt to make true jewels to depart from their proper color, and all of them to be so handsomely colored, that they may show like natural jewels. Lastly, I shall show how to made Smalt of divers colors.

## Chapter I

"Of certain Salts used in the composition of Gems."

E will first set down certain operations, which are very necessary in the making of gems, lest we be forced to repeat the same thing over again. And first,

"How to make Salt Soda."

The herb Kali or Saltwort is commonly called Soda. Grind this Soda very small, and sift it into a powder. Put it into a Brass Cauldron and boil it, pouring in for every pound of Soda, a Firkin of water. Let it boil for four hours, till the water be consumed to a third part. Then take it form the fire, and let it stand twelve hours, while the dregs settle to the bottom, and the water becomes clear. Then drain out the water with a Linen cloth, into another vessel, and pour fresh water into the Cauldron. Boil it again, and when it is cold, as before, and all the dross settled, filtrate the clear water out again. Do as much the third time, still having a care to try with your tongue, whether it be still Salt. At last, strain the water, and set it in an earthen vessel over the fire, keeping a constant fire under it, until the moisture being almost consumed, the water grow more thick, and be condensed to Salt, which must presently be taken out with an Iron ladle, and of five pounds of Soda, you will have one pound of Salt.

"How to make Salt of Tartar."

Take the Lees of old wine, and dry it carefully. It is commonly called Tartar. Put into an Alimbeck, made in such sort, that the flame may be retorted from the top, and so augment the heat. There let it burn, you will see it grow white, then turn it with your Iron Tongs, so that the upper part which is white may be at bottom, and turn the back up to the flame. When it has ceased smoking, take it out, and break part of it, to see whether it be white quite through, for that is an argument of the sufficient burning, because it often happens, that the outside only is burned, and the rest of it remains crude. Therefore, when it has gained the color of Chalk, it must be taken out. And when it is cold, grind it, and lay it in water in some wide-mouthed vessel a quarter of a day. When the water is grown clear,

filtrate it, and strain it into another vessel, and the pour water again unto the settlement, observing the same things we spoke of before, until the water has taken out all the Salt, which will come to pass in the third or fourth time. Pour your water under it, and attend the work until the water be consumed by the force of the fire, which being done, the Salt will stick to the bottom. It being thus made, preserve it in a dry place, lest it turn to oil.

## Chapter II

"How Flint, or Crystal is to prepared, and how Pastils are boiled."

The matter of which gems are made, is either Crystal or Flint, from whence we strike fire, or round pebbles found by the river sides. Those are the best which are taken up by the river Thames, white, clear, and of the bigness of an Egg. For of those are made best counterfeit gems, though all will serve in some sort. Some think that Crystal is the best for this purpose, because of the brightness and transparency of it, but they are deceived. The way of making gems, is this, take river pebbles and put them into a Fornace, in that place where the retorted flame is most intense. When they are red hot, take them out and fling them into water. Then dry them, and powder them in a Mortar, or a Handmill, until they are very fine, put them into a wide-mouthed vessel, full of rain water, and shake it well in your hands, for so the finest part will rise to the top, and the grossest will settle to the bottom. To that which swims at top, pour fresh water, and stir the dust again. And do this often, until the gross part be quite separated and sunk down. Then take out the water, and let it settle, and in the bottom there will lie a certain filmy matter. Gather together, and reserve the refined powder. But while the stone is ground, both the Mortar and the mill will lose somewhat of themselves, which being mixed with the powder will foul the gem. Therefore it is worth the labor to wash that away. To which end, let water be often poured into the Lavel, and stirred about, the dust of the Mortar will rise to the top, by reason of its levity, and powder of pebbles will retire to the bottom by the reason of its weight. Skim the Lavel, and separate them with a spoon, till all that sandy and black dust be taken off, then strain out the water, and reserve the powder to dry. These being done, we must teach,

"How Pastils are boiled."

Artificers call those pellets which are made of salts, and the forenamed powder and water, Pastils. Take five parts of Salt of Tartar, as many of Salt of Soda, double the quantity of these of the fore spoken powder of pebbles, and mix them very well in a stone Mortar. Sprinkle them with water and wet them, so that they may grow into a paste, and make Pastils of them in bigness of your fist. Set them in the Sun, and dry them well. Then put them into a Fornace of reverberation, the space of six hours, increasing the fire by degrees, that at last they may become red hot, but not melt, therefore use no Bellows. When they are baked enough, let them cool, and they will become so hard, that they will endure almost the Hammer.

## Chapter III

"Of the Fornace, and the Parts thereof."

Now the Fornace is to be built, which is like to that of Glass makers, but less according to the

proportion of the work. Let your Fornace be eight foot high, and consist of two vaults, the roof the lower must be a handful and a half thick. The vault itself must have a little door, by which you may cast in wood to feed the fire there. Let it also have on the top, and in the middle of its roof, a hole about a foot in breadth, by which the flame may penetrate into the second vault, and reach the upper roof, whence the flame being reverberated, does cause a vehement heat. In this upper vault there must be cut out in the wall small holes of a handful in breadth, which must open and shut, to set the pots and pans in on the floor, and to take them out again. Artificers call these pots Crucibles. They are made of Clay, which is brought from Valencia, and does very strongly endure fire. They must be a finger thick, and a foot and a half deep, their bottom somewhat thicker, lest they should break with the force of the fire. All things thus provided, cast in your wood and fire, and the Fornace heat by degrees, so that it may be perfectly hot in a quarter of a day. Your workmen must be diligent to perform their duty, then let the Pastils, being broken into pieces about the bigness of a Walnut, be put in Crucibles, and set in the holes of the Fornace built for that purpose, with a pair of Iron Tongs to every pot. When they melt, they will rise up in bubbles, growing greater and greater, must be pricked with sharp wires, that the vapor passing out, the bubbles may sink down again, and not run over the mouth of the Crucibles. Then let other pieces be put in, and do as before, until the pots be filled to the top. And continue the fire for a whole day, until the matter be concocted. Then put an Iron hook into the pots, and try whether the matter has obtained a perfect transparency. Which if it has, take it out of the post with Iron instruments for that purpose, and cast it into clear water, to wash off the filth and stains, and to purge out the Salt. For when gems are made, on a sudden the Salt breaks forth, as if it were pulled out, and overcast them like a cloud. Yet there must be a great deal of diligence used. While you draw out this vitrified matter, let it touch the sides of the Fornace for it will cleave thereto like Birdlime, hardly to be pulled off without a part of the wall. As also lest it fall into the vessels. For it is very difficult again to separate it, and it prejudices the clearness of the Glass. When it is cold, put it again into the Crucibles, and let it glow for two days, until it be concocted into perfect Glass. When this vitrified matter has stood so for two days, some, to make it more fine and bright, lest it should be specked with certain little bubbles (to which Glass is very subject) put into the Crucible some White Lead, which presently grows red, when melts with the Glass and becomes clear and perspicuous. Make your withdrawal then with an Iron hook, for if it be clear of those bubble, it is perfected, and so will be a perfect mass of gems. Now we will teach the several colors, yellow, green, or blue, wherein we will cast our gems.

#### Chapter IV

"To Make Colors."

While the Crystal is preparing in the Fornace, by the same fire the colors may also be made. And first,

"How to make Crocus of Iron."

Take three or four pounds of the Limature of iron, wash it well in a broad vessel, for by putting it into water, the weight of the Iron will carry that to the bottom, but the straws and chips, and such kind of filth, will swim on the top, so you will have your filings clean and washed. Then dry it well, and put it into an earthen glazed pot with a large mouth, and pour into it three or four gallons of the best and sharpest Vinegar. There let it macerate three or four weeks, stirring it every day seven or eight times with an Iron rod. Then giving it time to settle, pour out the Vinegar into another pot, and put fresh Vinegar into the Iron, and do this, till the Vinegar has consumed all the filings. Then put all the

Vinegar into an earthen vessel, and set it on the fire, and let it boil quite away. In the bottom there will remain a filmy dirty matter, mixed with kind of a fatness of the Iron, which the fire by continuance will catch hold of. Let it burn, and the remaining dust will be Crocus of iron. Others file your rusty nails, and heating them red hot, quench them in Vinegar, then strain them and dry the rust, and set it again to the fire, till it be red hot, then quench it again with Vinegar, and this they do three or four times. At length they boil the Vinegar away, and take the remaining Crocus from the bottom. Next remains to show,

"How to reduce Zaphara into Powder."

A little window is to be made out of the side of the Fornace, nigh to which must be built a little cell or oven, so joined to the mouth of the oven, that the flame may be brought in through a little hole. Let this cell have a little door without, to admit the workman's hand upon occasion. Let this cell be a foot in length and breadth. Set the Zaphara upon a potters tile, into the cell, and shut the door. Let it be red hot, and after six hours take it out and put it into water, so will it cleave into pieces. Let it be dried, stamped, and so finely seirced, that it may scarce be felt. But if it cannot be effected with a pestle and mortar, pour water upon the powder, and stir it with your hands, and let it settle for a while, then strain it into another vessel, and pour fresh water into the powder, and reiterate this so often, till that which settles, being beat and brayed, do pass through with water. Then dry it, and it will become very fine powder.

"How to burn Copper."

Set the filings of Copper, with an equal quantity of Salt mixed in an earthen pot, over the fire, and turn it about three or four hours with an Iron hook, that it may be burned on all sides. There let it burn a whole day. Then take it out, and divide it into two parts, lay the one part aside, and set the other with Salt on the fire again, for an artificial day. Do the same three or four times, that it may be more perfectly Calcined, always having a care that it be as hot as may be, but that it melts not. When it is burnt, it is black.

## Chapter V

"How Gems are colored."

All things being thus prepared, there is nothing more, I think, remains to make an end of this work, but to know how to color them. And we begin with the way,

"How to dye a Sapphire."

Artificers begin with a Sapphire. For when it is colored, unless it be presently removed from the fire, it loses its tincture, and the longer it remains in the fire, the brighter it grows. Put a little Zaphara, as they call it, into a pot of glass, and two Drachms to a pound of Glass, then stir it continually from top to bottom with an Iron hook. When it is very well mixed, make trial whether the color please you or no, by taking a little out of the pot. If it be too faint, add some more Zaphara, if too deep, put in more Glass, and let it boil for six hours. Thus you may,

"Color Cyanus,"

Or Seawater, another kind of Sapphire. Beat your Calcined brass into very fine powder, that you may scarce feel it, for otherwise it will mix with the crystal, and make it courser. The quantity cannot be defined, for there are lighter and deeper of that kind. For the most part, for one pound one Drachm will be sufficient.

"How to counterfeit the color of Amethyst."

To a pound of Crystal, put a dram of that they call Manganese, and so the color is made. If the gem be great, make it paler, if small, make it deeper. For they use such for rings, and other uses.

"To counterfeit the Topaz."

To every pound of Glass, add a quarter of an ounce of Crocus of iron, and three ounces of red lead, to make it of a brighter red. First put in the lead, then the Crocus of iron.

"The Chrysolite."

When you have made a Topaz, and would have a Chrysolite, add a little more Copper, that it may have a little verdure. For the Chrysolite differs from the Topaz in nothing, but that it has a greater luster. So we are wont,

"To Counterfeit an Emerald."

This shall be the last. For we must let our work be as quick as possible, because the Copper being heavy, when it is mixed with the Crystal, does presently sink down to the bottom of the pots, and so the gems will be too pale of a color. Therefore thus you must do. When you give the tincture to a Cyanus, you may easily turn it into a Smaragde, by adding Crocus of iron, in half the quantity of the Copper or Brass, viz., if at first you put in a fourth part of Copper. Now you must add an eighth part of Crocus of iron, and as much Copper. After the colors are cast in, let it boil six hours, that the material may grow clear again. For the casting in the colors will make them contract a cloudiness. Afterwards let the fire decrease by degrees, until the Furnace be cold. Then take out the pots and break them, wherein you shall find your counterfeit precious stones.

## Chapter VI

"How Gems may be otherwise made."

The manner which I have set down, is peculiar and usual to our artificers, and by them is also accounted a secret. But I will set down another way, which I had determined always to keep secret to myself. For by it are made with less charge, less time, and less labor, much more refulgent, bright, and livelier gems. Whose surfaces and luster, the Salt shall not deface in a much longer time. Although those old counterfeits which are found at Puteoli, in the Mortar of ruined houses, and on the shores, are yet very bright, and of a perfect clearness, so that they seem beyond the imitation of our age. Yet I will endeavor by this way, not only to equal them, but make them much better. Wherefore give ear, and believe. The materials are thus made. Take the comb of a Cock, and cutting his gullet in two, keep the head and neck. Put it into a pot, and set it in a hard fire. Stop it close that

no coals or ashes arising with the smoke, or soot, fall in, and spoil the luster of it. When the fire is kindled, you will hear it hiss. When it is red hot, take it up with Iron tongs, and quench it in clear water, and dry it. Do this three times, changing the water, lest there be any filth. Then grind it on a Marble till it be so fine that you may blow it about, and reserve it for use. Thence have you the Philosopher's Stone, most fragrant in fire, and chief in the triplicity. If you are ignorant of the Philosopher's Stone, learn it from these verses, which I found in an old manuscript.

"Arctus est hominis, qui constat sex elementis.

Cui p si addideris, s. in. m. mutare si bene scis.

Hoc erit os nostrum constans lapis Philosophorum."

Now we have advised you of the materials. Let us advise also about the color. And first of all, I will show you,

"How to counterfeit a Topaz."

Put your material into a pot, and cover it with a lid full of holes. Over which there must be laid another, that it may exhale, and yet receive not hurt from the smoke. Let it stand in its Fornace to the middle of the space of a whole day, and it will be a Topaz. Now,

"To counterfeit a Chrysolite,"

Cram the Cock, and for every ounce give him to eat two grains of the beloved Flower of Venus. Stroke him, and in due time you shall see.

"To make an Emerald."

Feed the Cock again, and for every ounce, give him four grains of Wheat, and he will shine with a most bright luster. But,

"To make a Jacinth,"

Give the Cock grains of the Bloody Stone, instead of Wheat, and he will easily lay hold of them.

## Chapter VII

"Of Several Tinctures of Crystal."

I have declared diverse Tinctures of Glass, and those no vulgar and common ones, but such as are rarely known, and gained, and tried with a great deal of labor. Now I will relate some ways of staining Crystal, and especially those that are choice, and known to very few, if not only to myself.

**"To stain Crystal with the color of Jacinth, or a Ruby, without breaking, or wearing it."**

**Take six parts of Stibium, four of Orpin, three of Arsenic, as much of Sulfur, two of Tutty. Beat them all asunder, and sift thru a fine Seirce. Put them into a pot. Hang your Crystal by wires, or cover it over with the powders, and so set it on the fire, that it may be hot, four or five hours. But use no Bellows, lest it break in pieces or melt. It is a certain sign of being perfectly colored, if you take out a piece, and that be of a bright shining color. Otherwise deliver it to the fire again, and after some time, try it again. But you must have a great care, lest it cool too suddenly when you take it off the fire, for it will crumble and fall to pieces. If a violet color pleases you, take it soon from the fire. If you would have a deep purple, let it stand longer. We can make a violet with Orpin only.**

**"To turn a Sapphire into a Diamond."**

**This stone, as all others, being put in the fire, loses his color. for the force of the fire makes the color fade. Many do it several ways. For some melt Gold, and put the Sapphire in the middle of it. Others put it on a plate of Iron, and set it in the middle of the Fornace of reverberation. Others burn it in the middle of a heap of Iron dust. I like to do it a safer way, thus. I fill an earthen pot with live lime, in the middle of which I place my Sapphire. And cover it with coals, which being kindled, I stop the Bellows from blowing, for they will make it fly into pieces. When I think it changed, I take a care that the fire may go out itself. And then taking out the stone, I see whether it has contracted sufficient whiteness. It has, I put it again in its former place, and let it cool with the fire. If not, I cover it again, often looking on it, until the force of the fire has consumed all the color, which it will do in five or six hours. If you find that the color be not quite vanished, do again as before, until it is perfectly white. You must be very diligent, that the fire heats by degrees, and also cools. For it often happens, that sudden cold does either make it congeal or fly to pieces. All other stones lose their color like the Sapphire. Some sooner, some later, according to their hardness. For the Amethyst you must use but a soft and gentle fire. For a vehement one will over harden it, and turn it to dust. This is the art we use, to turn other precious stones into Diamonds, which being cut in the middle, and colored, make another kind of adulterating gems. Which by this experiment we will make known. And it is,**

**"How to make a stone white on one side, and red or blue on the other."**

**I have seen precious stones thus made, and in great esteem with great persons, being of two colors. On one side a Sapphire, and on the other a Diamond, and so of diverse colors. Which may be done after this manner. For example, we would have a Sapphire should be white on one side, and blue on the other. Or should be white on one side and red on the other. Thus it may be done. Plaster up that side which you would have red or blue, with Chalk, and let it be dried. Then commit it to the fire, those ways we spoke of before, and the naked side will lose the color and turn white, that it will seem a miracle of nature, to those that know not by how slight an art it may be done.**

**"How to stain glass of diverse colors."**

**I will not pass by a thing worth the relation, which happened by chance while we were making experiments. The flour of Tin takes away the perspicuity of Crystal Glass, and makes it of divers colors. For being sprinkled upon Crystal Glasses that are polished with a wheel, and set to the fire, it does variously color them and makes them cloudy. So that one part will look like a stone, and another like an Opal of diverse colors. But you must often take it out from the fire, and order it rightly, until it is according to your desire. I have before told you how to make flour of Tin for the purpose. I will add somewhat more, indeed no secret, nor very necessary, but that nothing may be omitted by us in this work, viz.**

**"How to make a Jacinth,"**

**Beautiful enough, and not much unlike a true one. Put Lead into a hard earthen pot and set it on the fire in a Glass makers Fornace, there let it remain for some days till the Lead be vitrified, and it will be of the color of a Jacinth.**

**"To counterfeit an Emerald."**

**You may do this almost in the same manner, and it will resemble the color of a pleasant green Corn. Dissolve Silver with strong water, then casing into the water some plates of Copper, as I told you, it will cleave to them. Gather it together, and dry it, and set it into a Glass makers Fornace in an earthen pot. Within a few days it will become an Emerald. To do the same with other metals, I will leave to the trial of others. It is enough for me to have found out and discovered the way.**

**"To counterfeit Carbuncles."**

**This we do with Orpin, and use it in some ornaments. For they are brittle, and of a most flagrant color. They have much of the scarlet blush and cast forth red sparkles. Take four ounces of Orpin, and grind it small. Then put it into a Glass vessel whose bottom you must fortify against the force of the fire with Mortar made with straw, and stop the mouth gently. The fire being kindled, the smoke rises up and the thinnest part of the material will rise to the top. And you will see it stick to the sides of the glass and the neck. It will grow bigger by degrees, and new parts still flying up, will make it grow thicker. And like boiling water gather into bubbles which at last will increase so big, that they will fall down. Some will stick to the neck of the glass. All of a most flagrant color, but brittle and small. Break the glass and take off with a sharp point of a knife, those red congealed bubbles which stick to the glass and use them. If you would make one great one of those little bubbles, lay a great many little ones upon a piece of glass, and melt them, and they will run into one. A most pleasant sight to see.**

## **Chapter VIII**

**"Of making Smalt or Enamel."**

**After gems we will endeavor to make Smalt or Enamel. It is a work almost of the same nature, and of the same mixture and colors; this only difference is between them, that in gems the glass is transparent, in this it is more dense and solid. In ancient times they made their checker or mosaique work of it. And Goldsmiths do use it in coloring and enameling Gold. It is tin that gives it a body and solidity.**

**"To make white Enamel,"**

**Take two ounces of Lead ashes, four of Tin and make it into a body, with double the quantity of Glass. Roll it into round balls, and set it on a gentle fire all night. Take heed it stick not to the sides of the pot, but stir it about with an Iron Spattle, and when it is melted, increase the fire, and business is done.**

**"To make black Smalt ."**

To a pound of Glass, you must add a Drachm of Manganese, for so it will be of the color of a Lion. Then add a Drachm of Zaphara, and the mixture will turn black. Make often trial, if it be of a dark purple or violet color. For the Tin that gives it the body, will make it blacker.

"To make Smalt of a deep Yellow."

You may put to every pound of Crystal a little Crocus Martis, and tree ounces of Jalloline, as they call it, which engravers use. At last, Lead and Tin. But if you desire,

"To make Smalt of a paler yellow,"

Instead of Jalloline, add Jaletto, and you will have your desire.

"To make green Smalt."

Add burned Copper, and so it will be of a deeper color. But if you desire it a paler, add the flakes of Copper, which fly off while the Smith hammers it, being red hot.

"To make red Smalt,"

Add the Rust of Iron, very finely beaten. But when you would,

"Smalt dark on one side, and transparent of the other,"

Make your Pastils of earth, and double as much Glass. Set it a whole night in the fire of reverberation, and let it melt in a convenient vessel, stirring it with an Iron rod. So you shall perceive both transparent and opacous parts in the same little orb. So,

"To make Smalt of the color of Amethyst."

It is done with nothing but Manganese. And if you would have it of a deeper color, add more of the body, that is, of the flour of Lead and Tin.

"To make Smalt of sky-color."

It may be effected with Zaphara, by adding somewhat more of the body.

"To make speckled Smalt,"

Which being full of small specks, shall seem to be compounded of a great many Lice, and very pleasant to behold. The opacous Smalt being made, pour it upon Marble, and then presently sprinkle some Crocus upon it, or drop some pale color in specks, all over it, and you shall have your desire.

"To make Smalt of two colors,"

Cast Smalt first of one color upon a Marble, as before. And presently after, some of another color upon that. Then with an Iron rod press them close, and join them together.

**"To make the best kind of Smalt,"**

**Such as Goldsmiths use. To every pot allow two roles of Sal Soda, and some sand, of which Glass is made, and it will be much more perfect.**

## **CHAPTER IX**

**"To make Smalt of a clear rose color."**

**The most skillful Glassmakers do labor very much, in coloring Smalt of a rose color, which is commonly called Rossiclere. Seeing that in former times they did it most beautifully and artificially. I will set down what both I myself have done in it, and what I have received from other friends. I have performed the best I could, to show others an opportune way of making better. The manner is this. Cast ten pounds of Crystal in a pot, and when you know it to be well melted, add a pound of the best red Lead, by half at time, stirring it with an Iron rod as fast as you can, for the weight of it will make it sink to the bottom. When it is well mixed, take it out of the pot with Iron instruments fit for the purpose, and cast it into water. Do this thrice. Then mix with it five ounces of Tin Calcined, and Cinnabaris of a most bright color. And so stirring them about for three hours, let them stand a while. When this is done, add moreover three ounces of Vitrified Tin. Beat them together without any intermission, and you will see a most lively rose color in the Glass, which you may use in Enamelling Gold.**

### **To make Glass of Tin**

**Set a pound of Tin in a strong earthen pot, into the fire. Let it heat and melt, then remove it with Iron Tongs into the hottest flames of the Glassmakers Fornace, for three or four days. Afterwards, the pot being taken out, and cold. Break it, and in the top you will find glass of a Saffron color, not clear. But the longer it stands in the fire, the more perfect it will grow. Neither have I known better in this kind, of those many that I have tried. It must be reduced into fine powder. For the which not only a Mortar and Mills will be requisite, but also a Porphyrian stone. If it is too florid, you may make it of a more faint color, by adding Glass to it.**

**"Another way to make it."**

**This is only for friends. Take nine parts of burnt Tin, seven of Lead, two of Cinnabaris. Of Spanish Solder and Tartar, one part and a half. Of the Blood stone one part, of Painters Red a fourth part. And do with it, as in the former.**

## **Chapter X**

**"Of leaves of Metal to be put under Gems."**

There are certain leaves of metal laid under Gems, which being perspicuous, are thereby made paler or deeper, as you will. For if you would have them of a fainter color, you must put under them leaves of a more clear brightness. If of a deeper, leaves of a darker hue. Moreover, Gems being transparent, are seen quite through, and discover the bottom of the ring. Which takes much of their beauty off. This is an invention of later times, who by terminating the transparency of stones, which leaves of a most bright and pleasant color, do sit and make up, and mend the color of the stones. I have been very much delighted in this kind of work, and therefore will deliver it particularly. The leaves are to be made either of Copper alone, or of Copper, Gold, and Silver, mixed together. I will speak of those which are made of Copper alone. You must buy at the Braziers shops some thin plates of Copper, of the thickness of strong paper. That they may be the easier made thinner. These you must cut into pieces of three fingers in length, and two in breadth, so that a sheet of two pounds, will be divided into a hundred and thirty parts. These we must divide again into two parts, that they may be hammered more easily. Take forty and beat them, as artificers do Gold, when they beat it out into thin Rays. Let the Anvil and Hammer be smooth and polished, lest the heavy strokes should make dents in the Copper, and break it. Discontinue your work by turns, so that you may Hammer the Copper while it is hot, and prepared by the fire. And put it into the fire, when it is cold. For if you do otherwise, it will break in pieces; which you must presently remove from the rest. For those that are broken, will break others. But that they may be more easier prepared, when they begin to be extenuated, I make use of this invention. There must be prepared two plates of Iron, of a hand square, and the thickness of paper. Double one of them, that it may receive the other within the folds of it. So that they may receive the plates of Copper in the middle. And enclose them on all sides, that they can neither flip out, nor any dust or ashes fall in, to stick to them. When you have thus enclosed the Copper plates, put them into the fire, and heat them. When you have thus enclosed the Copper plates, put them into the fire, and heat them. Then take them out with Iron Tongs, and shaking off the ashes, beat them with your Hammer till they are cold. And so they will become thin and fine Rays. But while you are beating one, set other to heat. And do this eight times over, until you have hammered them very thin, and made them fit for your purpose. It will be worth your labor to look often upon them, to see if any have broken in the working, for they will break their fellows. Because they are often found to turn black in the workings and foul, so that they often deceive the eye, it is therefore fit, that you have a pot of water ready, with an equal quantity of Tartar, and Salt in it, and let it boil over the fire. Put in your Rays, and stir them about continually, till they are boiled white. Then take them out, and wash them in a pot of clear water, until they are very clean. Then dry them with a Linen cloth, and then heat them, and beat them on the Anvil again, as before, until they spread into Rays, as thin as leaf Gold. When this work is to be done, the Hammer and Anvil must be as smooth and polished, and bright, as a Looking-glass which you may effect in this manner. First of all, hold them to the Grindstone, where they grind knives, until they are smoothed and planed. Then rub them with fine sand, and Pumice stone. Afterwards glaze them with a wheel, and polish them with a plate of Lead, and powder of Emerald. If you use any other art, you will but lose your labor. Thus in two days your work will be finished, that is, by heating your plates, eight or ten times, and preparing them, and by whitening them four times at least. Finally, examine them all, whether they are whole, and of a sufficient thinness. So that if any remain too thick, they may again be brought to the Hammer and perfected. But I must advise you, the thinner they grow, the less time they must lie in the fire, because they will presently melt. And so also in the water, because the Salt will eat into them. At last, cut them with Shears into square pieces, that they may be convenient for use.

## "How leaves of Metals are to be Polished."

The plates being thus thinned and finished, we will fall to polishing of them. But first we must provide tools, wherewith to perform it. Take a plate of Copper of a foot in length, and a hand in breadth, most exquisitely burnished, that it may be as smooth as a Looking-glass. Bow it either with your hand, or a Hammer, by little and little, into the form of a semi cylinder. Then turn a piece of wood, sot hat it may be equal, and fit for it in every part, and be received into the convexity of it, where being fastened with four nails at the corners of the plate, it may remain steadfast. Fix this wood upon a little frame, with two bars of a foot height, fastened to the ends of it. Now we will begin to burnish the plates, which must be thus done. Provide Chalk made into fine powder, after this sort, take some beaten Clay, wrap it in a clean and indifferently fine cloth, and put it into a washing bowl full of water. Stir it about here and there, in the water, that the finest part may be washed through and the courser remain in the cloth. Then put the new Chalk into the cloth again. Stir it and strain it till it all passes through the cloth, the then suffer the water to settle, and Seirce it thru a strainer. Only changing the water, unto no gross settlement remains. Then lay the cloth over the mouth of the vessel, which must receive it, and tie it slack on. So strain it, that you may be the more sure, that nothing but what is very fine can pass through. Then press out the water, and reserve the chalk. Lay this Clay, thus prepared upon the Copper, and rub it with a Poplar stick, until it shines like Gold. Then wash it with water, over a wide mouthed pan, that may receive the water. After this, have a Blood-Stone ready, very well polished, upon a plate of Lead, with the dust of Emerald, it will become most exquisitely smooth. Therefore, lay your Rays of Copper upon the Copper, and spread it abroad with the thumb of your left hand. Then cast on the Clay, and pour water on to wash it, and then wipe it off, and let only the water remain to fasten them upon the Copper. Then take into your hands the stone, being fastened to a stick. And polish the plates with it, having a great care that they do not run into wrinkles. For then they are quite spoiled. But when they begin to move, pour on some of the water, and that will fix them again. Continue this, until you have made it all over as bright and smooth as a Looking-glass. A token of their perfect polishing is, when no marks of the running of the stone is seen upon them. Then taking them off from the wood, cast them into a pot of water, until the rest are all finished. And then wrap them in a clean Linen cloth. Dry them, and lay them up in boxes, free from all dust and filth. But bend them like a half pillar, so that the polished side may be inward, and tie them so with a string.

## Chapter XII

### "Of building a Fornace for the coloring of Plates."

Now we will show how to color them. But first, let us describe the Fornace, wherewith it must be done. Therefore let a Fornace be made of Iron plates of a convenient thickness. Let it be a foot in height, as much in the diameter of the length. Let it be covered on the top, with a circular plate. In the center of the roof of it, cut a round hole, a handful in breath. And set another Fornace upon it, of the same length and breadth, and make a hole in that also, which must be set against the other, and join them close together. Make a little door in the lower Fornace, close to the ground. Let it be made with an arch, four fingers wide, and jet out half a foot, like the mouth of an oven, and be joined in the same manner to the great Fornace. Then kindle your coals in another place, until they cease smoking. And with Iron Tonges cast them into the foresaid Fornace. Heat it very well, and let the

outward Fornace or mouth of the oven be filled half way with live coals. These being thus disposed, fall to coloring the plates. And first, I will teach you,

"How to color plates with a purple color."

Take the plates tied about with thread, as I told you, and fit them upon a pair of Iron Tongs, which you must fasten at the forefend with an Iron ring, that they may not open. Hold them upon the hole of the upper Fornace, that they may receive the ascending smoke. And turn them about, until by degrees you shall perceive them gather a purple color, without any other smoke then what arises from the heat of the coals. When you think them colored enough, remove them from the smoke and lay them aside.

"How to make them a Sapphire color."

It is done much after the same way. For taking the Rays in an Iron Tongs, and holding them over the hole of the Fornace, cast upon the coals through the low arched door, the feathers of a Goose, which grow upon her breast, and then lay upon them a red hot Iron rod. For the smoke of the feathers, arising through the tunnel of the Fornace, will beat upon the Rays, and make them of a Sky color. When the Iron rod grows cold, take another and put in. It is very admirable, how on a sudden these Copper Rays will change several colors. Wherefore, when they have obtained the color which you desire, take them off the Fornace presently, or otherwise they will alter into another.

"How to make them a Silver color."

Take a little Silver, and dissolve it with Aqua Fortis. Then pour some fountain water into it, and your Copper Rays. Presently the water will be troubled, and will stick upon the Copper like Silver Fleeces. Cast away the water, and wash the Silver, and dry it in the Sun. And when it is dry, lay it upon a Marble, and mix with it an out of Tartar, and as much ordinary Salt. Grind them together, till they be well mixed. This being made into powder, lay it on Copper, and rub it with your fingers, and it will make it shine like Silver. Then spread the Rays upon the round wood, and the Copper. Wet them with water, lay the powder on them, and rub them with your thumbs, that they may become of a Silver color. Steep them in water, and Levigate them with the Blood stone upon the before mentioned Copper. Then set them in the smoke, and they will shine with a sky color.

"How to make them of the color of an Emerald"

It is very difficult, and there scarce is one of very many that will prove right. First make your Rays of a sky color, as before. Then take those which have not taken that color rightly, and lay two of them upon the hole of the Fornace. And through the vault of the little door, fling some leaves of Box upon red hot plates of Iron, where they will crackle like Bay leaves, and send up a smoke through the hole, which will color the Rays. But before they come to be of a green color, they must pass through many other colors, as yellow, red, and sky color. But they must continue some time before they obtain a perfect green.

"How to make them red, like a Ruby."

Fling some flocks of Scarlet upon the live coals, and lay the thin plates over the hole, and the arising smoke will color them red.

"How to make them of the color of the Amethyst."

When it is made of a sky color, it passes through the color of the Amethyst. Take it therefore off in time, and you shall have your wish.

### Chapter XIII

"How Rays are to be colored by a mixture of Metals."

I will now show how Rays may be colored by mixture with other metals. Which is of more difficulty, but of longer continuance. The former cost but little labor, but they easily lose their color. These are harder to be made; but keep their color longer. Take half a pound of Copper, and melt it in a melting pot. Put into it a half a Crown of Gold. And when it is well melted, and mixed, add some Tartar, that when it cools, the top of it may be plain and smooth. After it is cold, set it aside. Then take another half pound of Copper, and melt it in the same manner. Mix a Drachm of Silver with it, and let it cool. Take it out of the pot, and file the outside of it smooth. For the least crack, or chap, would spoil the work. You may know whether there is any crack inside or out, by this sign; place it in an even poise upon a piece of Iron, and strike it with another piece. If it sound equally, and ring clearly, it is whole. If it does jar, it is cracked somewhere. Let your pieces of metal be about a finger in size. Beat them gently upon the Anvil, unless they break somewhere. Set them in the fire and season them, and when they are cold, beat them with the Hammer into thin Rays, as I have said before. If they chance to crack, file off the flaws. And when they have been seasoned twice or thrice, in the fire, have your pot of water ready. Prepared with Salt and Tartar, to whiten them, that you may more exactly find out the cracks.

"To make them of the color of a Ruby."

The plates being finished, if you would make them of a Ruby color, do it with flocks of Scarlet, as before. But then the rags must be of the mixture of Copper and Gold.

"To make them of the color of a Sapphire or Emerald."

Let the plates be of Copper and Silver. The Sapphire color is made with goose feathers. But the Emerald with Box leaves, holding them somewhat longer over the fire. And these are the experiments which I have made concerning Gems.