

The Thirteenth Book Of Natural Magick

The Proeme

I have taught you concerning monstrous fires, and before I depart from them, I shall treat of Iron mines, for Iron is wrought by fire. Not that I intend to handle the art of it, but only to set down some of the choicest secrets that are no less necessary for the use of men, in those things I have spoken of already, besides the things I spoke of in my chemical works. Of Iron there are made the best and worst instruments for the life of man, says Pliny. For we use it for works of husbandry and building houses, and we use it for wars and slaughters. Not only hard by, but to shoot with arrows, and Darts and Bullets, far off. For, that man might die the sooner, he has made it swift, and has put wings to Iron. I shall teach you the divers tempers of Iron, and how to make it soft and hard, that it shall not only cut Iron and other the hardest of substances, but shall engrave the hardest Porphyr and Marble stones. In brief, the force of Iron conquers all things.

Chapter I

"That Iron by mixture may be made harder."

It is apparent by most famous and well known experience, that Iron will grow more hard by being Tempered, and be made soft also. And when I had sought a long time whether it would grow soft or hard by hot, cold, moist or dry things, I found that hot things would make it hoard and soft, and so would cold and all the other qualities. Wherefore something else must be thought on to hunt out the causes. I found that it will grow hard by its contraries, and soft by things that are friendly to it, and so I came to Sympathy and Antipathy. The Ancients thought it was done by some superstitions worship, and that there was a chain of Iron by the river Euphrates, that was called Zeugma, wherein Alexander the Great had there bound the bridge. And that the links of it that were new made, were grown rusty, the other links not being so. Pliny and others think, that this proceeded from some different qualities, it may be some juices or minerals might run underneath, that left some qualities, whereby Iron might be made hard or soft, he says. But the chief difference is in the water that it is often plunged into when it is red hot. The pre-eminence of Iron that is so profitable, has made some places famous here and there, as Bilbilis and Turassio in Spain, Comum in Italy. Yet are there no Iron mines there. But of all the kinds, the Seric Iron bears the garland, in the next place, the Parthian. Nor are there any other kinds of Iron tempered of pure Steel. For the rest are mingled. Justine the historian reports, that in Gallicia of Spain, the chiefest matter for Iron is found, but the water there is more forcible then the Iron. For the tempering with that, makes the Iron more sharp, and there is no weapon approved among them, that is not made of the river Bilbilis, or tempered with the water of Chalybes. And hence are those people that live near this river called Chalybes, and they are held to have the best Iron. Yet Strabo says, that the Chalybes were people in Pontus near the river Thermodon. Virgil speaks,

"And the naked Chalybes Iron."

Then, as Pliny says, it is commonly made soft with Oil, and hardened by water. It is a custom to quench thin bars of Iron in Oil, that they may not grow brittle by being quenched in water. Nothing has put me forward more to seek higher matters, then this certain experiment, that Iron may be made so weak and soft by the Oil, that it may be wrested and broken with ones hands. And by water it may be made so hard and stubborn, that it will cut Iron like Lead.

Chapter II

"How Iron will wax soft."

I shall first say how Iron may grow soft, and become tractable, so that one may make Steel like Iron, and Iron soft as Lead. That which is hard, grows soft by fat things, as I said. And without fat matter, by the fire only, as Pliny affirms. Iron made red hot in the fire, unless you beat it hard, it corrupts. As if he should say, Steel grows soft of itself, if it be often made red hot, and left to cool of itself in the fire. And so will Iron grow softer. I can do the same diverse ways.

"That Iron may grow soft,"

Anoint Iron with Oil, Wax, Asafoerida, and Lute it over with Straw and Dung, and dry it. Then let it for one night be made red hot in burning coals. When it grows cold of itself, you shall find it soft and tractable. Or, take Brimstone three parts, four parts of Potters Earth powdered. Mingle these with Oil to make it soft. Then cover the Iron in this well, and dry it, and bury it in burning coals. And, as I said, you may use Tallow and Butter the same way. Iron wire red hot, if it cool alone, it will be so soft and ductible, that you may use them like Flax. There are also soft juices and herbs, and fat, as Mallons, bean pods, and suchlike, that can soften Iron. But they must be hot when the Iron is quenched, and juices, not distilled waters. For Iron will grow hard in all cold waters, and in liquid Oil.

Chapter III

"The Temper of Iron must be used upon soft Irons."

I have said how Iron may be made softer. Now I will show the tempering of it. How it may be made to cut sharper. For the Temper of it is diverse for diverse uses. For Iron requires several Tempers, if it be to cut bread, or wood, or stone, or Iron, that is of diverse liquors, and diverse ways of firing it, and the time of quenching it in these Liquors. For on these does the business depend. When the Iron is sparkling red hot, that it can be no hotter, that it twinkles, they call it Silver. And then it must not be quenched, or it would be consumed. But if it be of a yellow or red color, they call it gold or rose color. And then quenched in liquors, it grows the harder. This color requires them to quench it. But observe, that if all the Iron be tempered, the color must be blue or violet color, as the edge of a sword, razor or lancet. For in these the temper will be lost if they are made hot again. Then you must observe the second colors. Namely, when the Iron is quenched, and so plunged in, grows hard. The last is ash color. And after this if it be quenched, it will be the least of all made hard. For example,

"The Temper of a knife to cut bread."

I have seen many ingenious men that labored for this Temper, who, having knives fit to cut all hard substances, yet they could scarce fall upon a Temper to cut bread for the table. I fulfilled their desire with such a Temper. Wherefore to cut bread, let the Steel be softly tempered thus. Heat gently Steel, that when it is broken seems to be made of very small grains, and let it be excellent well purged from Iron. Then strike it with a hammer to make a knife of it. Then work it with a file, and frame it like a knife, and polish it with a wheel. Then put it in the fire, till it appear violet color. Rub it over with soap, that it may have a better color from the fire. Then take it from the fire, and anoint the edge with a linen cloth dipped in Oil of Olives, until it grows cold. So you shall soften the hardness of the Steel by the gentleness of the Oil, and a moderate heat. Not much differs from

this,

"The Temper of Iron for wood."

Something harder Temper is fit to cut wood, but it must be gentle also. Therefore let your Iron come to the same violet color, and then plunge it into waters. Take it out, and when it appears ash color, cast it into cold water. Nor is there much difference in,

"The Temper for Instruments to let blood."

It is quenched in Oil, and grows hard, because it is tender and subtle. For should it be quenched in water, it would be wrested and broken.

"The Temper of Iron for a Scythe."

After that the Iron is made into a Scythe, let it grow hot to the color of gold, and then quench it in Oil, or smear it with tallow, because it is subtle Iron, and should it be quenched in waters, it would either crumble or be wrested.

Chapter IV

"How for all mixtures, Iron may be Tempered most hard."

Now I shall show some ways where Iron on may be made extremely hard. For that Iron that must be used for an instrument to hammer, and polish, and fit other Iron, must be much harder then that.

"The Temper of Iron for files."

It must be made of the best Steel and excellently Tempered, that it may polish, and fit other Iron as it should be. Take ox hoofs, and put them in an oven to dry, that they may be powdered fine. Mingle well one part of this with as much common salt, beaten glass, and chimney soot, and beat them together, and lay them up for your use in a wooden vessel hanging in the smoke. For the salt will melt with any moisture of the place or air. The powder being prepared, make your Iron like to a file. Then cut it checker wise, and crosswise, with a sharp edged tool. Having made the Iron tender and soft, as I said, then make an Iron chest fit to lay up your files in, and put them all into it, strewing on the powders by course, that they may be covered all over. Then put on the cover, and lute well the chinks with clay and straw, that the smoke of the powder may not breath out, and then lay a heap of burning coals all over it, that it may be red-hot about an hour. When you think the powder to be burnt and consumed, take the chest out from the coals with Iron pinchers, and plunge the files into very cold water, and so they will become extremely hard. This is the usual temper for files, for we fear not if the files should be wrested by cold waters. But I shall teach you to temper them excellently,

"Another Way."

Take the pith out of goats horn, and dry it, and powder it. Then lay your files in a little chest strewed over with this powder, and do as you did before. Yet observe this, that two files supernumerary must be laid in, so that you may take them forth at pleasure. And when you think the chest, covered with burning coals, has taken in the force of the powder, take out one of the supernumerary files, and Temper it, and break it, and if you find it to be very finely grained within, and to be pure Steel ,

according to your desire, take the chest out of the fire, and Temper them all the same way. Or else, if it be not to your mind, let them stay in longer, and resting a little while, take out the other supernumerary file, and try it, till you have found it perfect. So we may,

"Temper Knives to be most hard."

Take a new ox hoof, heat it, and strike it with a hammer on the side, for the pith will come forth. Dry it in an oven, and as I said before, put it into a pot, always putting in two supernumeraries, that may be taken forth, to try if they be come to be pure Steel . And doing the same as before, they will be most hard. I will show,

"How an Habergeon or Coat of Arms is to be tempered."

Take soft Iron armor of small price, and put it into a pot, strewing upon it the powders above said, cover it, and lute it over, that it have no vent, and make a good fire about it. Then at the time fit, take the pot with Iron pinchers, and striking the pot with a hammer, quench the whole harness, red hot, in the foresaid water. For so it becomes most hard, that it will easily resist the strokes of Poniards. The quantity of the powder is, that if the harness be ten or twelve pounds weight, lay on two pounds and a half of powder, that the powder may stick all over. Wet the armor in water, and roll it in the powder, and lay it in the pot by courses. But, because it is most hard, lest the rings of a coat of mail should be broken, and fly in pieces, there must be strength added to the hardness. Workmen call it a Return. Taking it out of the water, shake it up and down in vinegar, that it may be polished, and the color be made perspicuous. Then make red hot a plate of Iron, and lay part of the coat of mail, or all of it upon the same. When it shows an ash color, workmen call it Berotinum. Cast it again into the water, and that hardness shall have one that will resist all blows. By the mixture of sharp things, Iron is made hard and brittle. But unless strength be added, it will fly in pieces with every blow. Therefore it is needful to learn perfectly how to add strength to it.

Chapter V

"Liquors that will Temper Iron to be exceeding hard."

I said that by antipathy Iron is hardened, and softened by sympathy. It delights in fat things, and the pores are opened by it, and it grows soft. But on the contrary, astringent things, and cold, that shut up the pores, by a contrary quality, make it extreme hard. They seem therefore to do it. Yet we must not omit such things as do it by their property. If you would have,

"A saw Tempered to saw Iron,"

Make your saw of the best Steel , and arm it well that it be not wrested by extinguishing it. Then make a wooden pipe as long as the Iron of the saw, that may contain a liquor made of water, Alom, and Piss. Plunge in the red hot Iron, and take it out, and observe the colors. When it comes to be violet, put all into the liquor, till it grows cold. Yet I will not conceal, that it may be done by a brass wire bent like a bow, and with Powder of Emril and Oil. For you shall cut Iron like wood. Also, there are tempered,

"Fishhooks to become extreme hard."

The hook serves for a part to catch fish. For it must be small and strong. If it be great, the fish will see it, and will not swallow it. If it is too small, it will break with great weight and motion. If it is soft, it will be made straight, and the fish will get off. Wherefore, that they may be strong, small, and not to be bent in the mouth, you shall thus Temper them. Of mowers scythes,

make wire, or of the best Steel , and make hooks thereof, small and fine. Heat them not red hot in the fire, for that will devour them. But lay them on a plate of red hot Iron. When they grow red, cast them into the water. When they are cold, take them out and dry them. Then make the plate of Iron hot again, and lay on the hooks a second time, and when an ash color, or that they commonly call Berotinus, appears, plunge them into the water again, that they may be strong. For else they would be brittle. So you may make,

"Cultrers extreme hard."

Albertus, from whom others have it, says, that Iron is made more strong, if it be tempered with juice of radish, and water of earthworms, three or four times. But I, when I had often tempered it with juice of radish, and horse radish, and worms, I found it always softer, till it became like Lead. And it was false, as the rest of his receipts are. But thus shall you make Steel extreme hard, that with that only, and no other mixture, you may make Cultrers very hard. Divide the Steel into very small pieces like dice, and let them touch one the other, binding Iron wires over them, fastening all with an Iron wire. Put them in the fire till they grow red hot, and sparkle, at least fifteen times, and wrap them in these powders that are made of Borax one part, oyster shells, Cuttle bones, of each two parts. Then strike them with a hammer, that they may all unite together, and make Cultrers , or knives, or what you will. For they will be extremely hard. For this is the most excellent sort of Steel , that only tempered with waters, is made most hard. There is another, but not so good. And unless well tempered, it always grows worse. It is this,

"To Temper a Graver to cut Marble."

Make your Graver of the best Steel , let it be red hot in the fire, till it be red or rose colored. Dip it into water, then take it away, and observe the second color. When it is yellow as gold, cast it into the water. So almost is,

"A Tool made to cut Iron."

When the same red rose color appears, plunge it into the water, or some sharp liquor, that we shall show. And you must observe the second yellow color, or wheat color, and then cast it into the water. These are the best,

"Tempers for Swords."

Swords must be tough, lest while we should make a thrust, they should break. Also, they must have a sharp edge, that when we cut, they may cut off what we cut. The way is thus. Temper the body of it with Oil and butter, to make it tough. And temper the edge with sharp things, that they may be strong to cut. And this is done, either with wooden pipes, or woolen cloths, wet with liquor. Use it wittily and cunningly.

Chapter VI

"Of the Temper of a Tool shall cut a Porphyr Marble Stone."

Our ancestors knew well to Temper their tools, wherewith they could easily cut a Porphyr stone, as infinite works testify that were left to us. But the way was shown by none, and is wholly concealed, which is a mighty disgrace to our times, when we neglect such rare and useful inventions, and make no account of them. That we might be freed from this dishonor, with great care, and pains, and cost, I made trial of all things came to my hand, or I could think of, by diverse ways and experiments, that I might attain unto it. At last, by God's great blessing, I found a far greater passage for to come to these things, and what

exceeds this. And I will not be grieved to relate what I found out by chance, while I made trial of these things. The business consisted in these difficulties. If the temper of the Graver was too strong and stubborn, with the vehement blow of the hammer it flew into pieces. But if it was soft, it bowed, and would not touch the stone. Wherefore it was to be most strong and tough, that it might neither yield to the stroke, nor fly asunder. Moreover, the juice or water the Iron must be tempered in, must be clear and pure. For if it be troubled, the colors coming from heat could not be discerned. And so the time to plunge the tools in would not be known, on which the whole art depends. So then, clear and purified juices will show the time of their temper. The colors must be chiefly regarded. For they show the time to plunge it in and take it out. And because that the Iron must be made most hard and tough, therefore the color must be a middle color between silver and gold. And when this color is come, plunge the whole edge of the tool into the liquor, and after a little time, take it out. And when it appears a violet color, dip it into the liquor again, lest the heat, yet remaining in the tool, may again spoil the temper. Yet this we must chiefly regard, that the liquors into which the Iron is plunged, be extreme cold. For if they be hot, they will work the less. And you must never dip an Iron into water, that other Iron has been dipped in before, for when it is grown hot, it will do nothing. But dip it into some other that is fresh and cold, and let this in the mean time, swim in some glazed vessel of cold water, that it may soon grow cold, and you shall have it most cold for your work. Yet these are,

"The hardest Tempers of Iron."

If you quench red hot Iron in distilled vinegar, it will grow hard. The same will happen, if you do it into distilled urine, by reason of the salt it contains in it. If you temper it with dew, that in the month of May is found on Vetches leaves, it will grow most hard. For what is collected above them, is salt, as I taught elsewhere out of Theophrastus. Vinegar, in which Salt Ammoniac is dissolved, will make a most strong temper. But if you temper Iron with Salt of Urine and Saltpeter dissolved in water, it will be very hard. Or if you powder Saltpeter and Salt Ammoniac, and shut them up in a glass vessel with a long neck, in dung, or moist places, till they resolve into water, and quench the red hot Iron in the water, you shall do better. Also Iron dipped into a Liquor of Quicklime, and Salt of Soda purified with a Sponge, will become extreme hard. All these are excellent things, and will do the work. Yet I shall show you some that are far better.

"To Temper Iron to cut Porphy Marble."

Take the fugitive servant, once received, and then exalted again, and shut it in a glazed vessel, till it consume in fire or water, so the Iron tool will grow hard, that you may easily have your desire. But if it be too hard, that it be too brittle, add more liquor, or else more metal. Yet take care of this alone, while you have found the measure of your work. For the Iron will grow strong and tough. The same also will be happily performed by the foul moisture of the Serpent Python, and by the wasting thereof. For the salt gives force, and the fat toughness. And these are the best and choicest that I have tried in this kind.

Chapter VII

"How to grave a Porphy Marble without an Iron Tool."

Some have attempted to do this without any graver, but with strong and forcible water, and this argument moved them to it. When they saw vinegar and sharp juices to swell into bubbles, being cast upon marble, and to corrode it, they supposed that if they should draw very strong sharp liquor from sharp and corroding things, that they might be able to do the same without labor. At last, thus they did it. Take a little Mercury Sublimate, and a little Salt Ammoniac. Distill these as I showed in glass stills. Then take a little Verdigrease, Tin Calcined, and of the Firestone, powder all these with Sal Gemma, and common salt, and Salt Ammoniac. Distill them, and pour the distilled liquor again upon the Foeces, and distill it again, and do it again the third time. Then keep the liquor in a vessel well stopped. When you go about your work, smear the Porphy marble with

goats suet, only touch not those parts you mean to have engraved. You must make a ledge about it, and when you pour on your water, it may not run off here and there. And the liquor poured on will eat most strongly. When it ceases to eat, cast it away, and pour on fresh, and do this so often, till you have engraved it so much as you please, and you have done.

Chapter VIII

"How Iron may be made hot in the fire to be made tractable for works."

Many seek most diligently, how by a secret art, Iron may be so tempered, that it may neither break, nor be shot through with guns. But these men do not take care of what they have before them, and seek for what they have not. For would they consider while the Iron heats, the thing they seek for so eagerly, is before their eyes. I say therefore, that the reason why swords break and fly in pieces, and breasts of Iron are shot through with guns, is, because there are flaws in the Iron, and it cleaves in diverse places, and the parts are ill united, and because these clefts are scarce visible. This is the cause that when they are bent or stricken, they break. For if you mark well, whenever knives or swords break in pieces, you shall always find these cracks and flaws, and the solid parts are not broken, and being bent, resist. But when I sought for the cause of these flaws, I found at last, that in Smith's shops, where Iron is made hot, they heap up coals over the Iron, and the refuse of coals, saying, the Iron will not heat so easily, if some rubbish of the coals and dust be not heaped over it. And with this trumpery dust, there are always mingled small stones, chalk, and other things gathered together in pieces, which, when they meet in fire, they cause many knots outwardly, or cavities inwardly, and cracks, that the parts cannot well fasten well together. Whence, though the business be trivial and of small regard, yet this is the cause of great inconveniences that follow. Wherefore, to avoid this impediment, I thought on this course to be taken. I cast my coals into a wooden bowl full of water. For they will swim on the top, (but the filth and bricks will fall to the bottom). Those that swim, I take out and dry them. And those I use for my works. What a blessing of God this profitable invention is! For thus men make swords, knives, bucklers, coats of mail, and all sorts of armor so perfect, that it were long and tedious to relate. For I have seen Iron breasts, that scarce weighed above twelve pounds, to be musket proof. And if we should add the temper to them, they would come to far greater effects.

Chapter IX

"How Damask Knives may be made."

Now while I set down these operations very pleasant, namely, how Damask Knives may be made to recover their marks that are worn out, and how the same marks may be made upon other knives. If then we would,

"Renew the waved marks of Damask Knives that are worn out,"

Polish a Poniard, sword or knife, very well with Powder of Emril and Oil, and then cleanse it with chalk, that no part may be dark, but that it may glister all over. Then wet it all with juice of lemons mingled with Tanners water, that is made with Vitriol. For when it is dry, the marks will all be seen in their places, and wave as they did before. And if you will,

"Make marks with Damask Knives,"

And that so accurately, that you can scarce know them from Damask Knives. Polish a knife very well, as I said, and scour it with chalk. Then stir with your hands, chalk mingled with water, and touching it with your fingers, rub the edge of the sword that was polished, and you shall make the marks as you please. When you have done, dry them at the fire or the sun. Then you must have a water ready wherein Vitriol is dissolved, and smear that upon it. For when the chalk is gone, it will dye it with a black color. After a little stay, wet it in water, and wash it off. Where the chalk was, there will be no stain; and you will be glad to see the success. You may with chalk make the waving lines running up and down. If anyone desires,

"To draw forth Damask Steel for work,"

You may do it thus. For without art it is not to be done. Too much heat makes it crumble, and cold is stubborn. But by art, of broken swords, knives may be made very handsomely, and wheels and tables, that silver and gold wire are drawn through, and made even by, to be used for weaving. Put it gently to the fire, that it may grow hot to a golden color, but put under the fire for ashes, Gip Calcined, and wet with water. For without Gip, when you hammer it, it will swell into bubbles, and will fly and come to be Dross and refuse.

Chapter X

"How polished Iron may be preserved from rust."

It is so profitable to preserve Iron from Rust, that many have labored how to do it with ease. Pliny says, that Iron is preserved from rust, by Ceruss, Gip, and liquid Pitch. Put he shows not how Ceruss may be made. Yet those that know how to make Oil of Ceruss without Vinegar, Iron being smeared therewith, is easily preserved from rust. Some anoint the Iron with deer suet, and so keep it free from rust. But I use the fat substance in the hoofs of oxen.