

The Twelfth Book Of Natural Magick

The Proeme

Before I leave off to write of fire, I shall treat of that dangerous fire that works wonderful things, which the vulgar call Artificial Fire, which the commanders of armies and generals, use lamentably in diverse artifices and monstrous designs, to break open walls and cities, and totally subvert them. And in sea fights, to the infinite ruin of mortal men, and whereby they often frustrate the malicious enterprises of their enemies. The matter is very useful and wonderful, and there is nothing in the world that more frightens and terrifies the minds of men. God is coming to judge the world by fire. I shall describe the mighty hot fires of our ancestors, which they used to besiege places with, and I shall add those that are of later invention, that far exceed them. And lastly, I shall speak of those of our days. You have here the compositions of terrible Gunpowder that makes a noise, and then of that which makes no noise. Of pipes that vomit forth deadly fires, and of fires that cannot be quenched, and that will rage under water at the very bottom of it, whereby the seas rend asunder, as if they were undermined by the great violence of the flames striving against them, and are lifted up into the air, that ships are drawn by the monstrous gulfs. Of fire balls that fly with glittering fire, and terrify troops of horsemen, and overthrow them. So that we are come almost to eternal fires.

Chapter I

"How diverse ways to procure fire may be prepared."

It is said that it fell out by accident, that sundry trees, frequently moved with winds and tempests, the bows of them rubbing one against another, and the parts smiting each other, and so being rarefied, caused heat, and took fire, and flamed exceedingly. Wild people that saw this, ran away. When the fire was out, and they wouldn't come nearer, and found it to be a great commodity for the body of man, they preserved the fire, and so they perceived that it afforded causes of civility, of conversing and talking together. Pliny says, it was found out by soldiers and Shepherds. In the camp, those that keep watch found this out for necessity, and so did Shepherds, because there is not always a Flint ready. Theophrastus teaches what kinds of wood are best for this purpose. And though the Auger and the handle are sometimes both made of one sort of wood, yet it is so that one part acts and the other suffers. So that he thinks the one part should be of hard wood, and the other soft. Example,

"Wood that by rubbing together will take fire."

They are such as are very hot, as the Bay tree, the Buckthorn, the Holm, the Piel tree. But Mnestor adds the Mulberry tree, and men conjecture so, because they will presently blunt the ax. Of all these they make the Auger, that by rubbing they may resist the more, and do the business more firmly. But the handle to receive them, is to be made of soft wood, as the Ivy, the wild Vine, and the like, being dried, and all moisture taken from them. The Olive is not fit, because it is full of fat matter, and too much moisture. But those are worst of all to make fires, that grow in shady places. Pliny from him, One wood is rubbed against another, and by rubbing takes fire, some dry fuel, as Mushrooms or leaves, easily receiving the fire from them. But there is nothing better then the Ivy, that may be rubbed with the Bay tree, or this with that. Also the wild Vine is good, which is another kind of wild Vine, and runs upon trees as Ivy does. But I do it more conveniently thus. Rub one Bay tree against another, and rub lustily, for it will presently smoke, adding a little Brimstone. Put your fuel nearer, or dry matter made of dry Toadstools, or leaves that are very fine, found about the roots of Coltsfoot, for they will soon take fire, and retain it. The West Indian's bind two dry sticks together, and they put a stick between them, which they turn about with their hands moved from them, and so they kindle fire. But since the mind of man seldom rests in the thing once invented, but seeks for new inventions, by man's industry there is found out,

"A stone that will raise fire with any moisture."

The way to make it is thus, Take quick Brimstone, Saltpeter refined, of each a like weight. Camphire the double weight to Quicklime. And beat them all in a Mortar, till they be so fine that they will fly into the air. Bind them all fast together, wrapt in a Linen Clout, and put them into an earthen pot. Let it be well stopped. Lute it well with Clay and Straw, and let it dry in the Sun. Then put them into a Potter's oven, and when the earthen vessel is perfectly baked, they will grow together, and be hard as stone. Take them out, and lay them up in a dry place for use. I went to try this in a haste, and my experience failed me. I know certainly, that some of my friends have done it. But the pot must not have any vent, for it will all burn away. Yet I have seen water cast upon Quicklime, and by putting Brimstone to it, it took fire, and fired Gunpowder. This I can maintain.

Chapter II

"Of the Compositions for Fire, that our Ancestors used."

Before I come to our compositions for fireworks, I shall set down those that our forefathers used in sea fights, and in taking or defending of cities. Thucidides says, that those that besieged Plataenenses, when the engines would do no good, they fell to fireworks. For casting about the walls bundles of stuff, and throwing in fire, Brimstone and Pitch, they burnt the wall. Whence arose such a flame, that until that time, no man ever say the like. Heron teaches, that in burning of walls, after you have made a hole through, you must put wood of the Pine tree under and anoint it with dry Pitch, and powdered Brimstone together, with Tar or Oil, and set this on fire. And elsewhere he teaches to burn with a pot. Take an earthen pitcher, and bind it about with plates of Iron on the outside, and let it be full of small Coal. Let there be a hole about the bottom to put in the Bellows. For when the coals take fire, by sprinkling on of Vinegar, Piss, or other sharp matter, the walls are broken. Vegetius teaches, what combustible matter must be used. And he uses burning Oil, Hards, Brimstone, Bitumen. Burning Arrows are shot in crossbows into the enemy ships, and these, being smeared with Wax, Pitch and Rosin, they quickly fire the decks, and so many things that afford fuel to the fire. I shall add,

"The Firedarts the Ancients used."

Ammianus Marcellinus described Firedarts, a kind of weapon made after such a fashion. It is an Arrow of Cane, joined with many Irons between the shaft and the head, and they are made hollow after the fashion of a womans Distaff, wherewith Linen thread is spun, in the midst of it, it has many small holes, and in the very hollow of it, is put fire with some combustible matter, and so is it easily shot forth of a weak Bow. For a bow that is strong, puts out the fire, and there is no means to put it out, but by casting on dust or Lees of Oil. Livy; Some came with burning torches, others carrying Tar, Pitch, and Firedarts, and the whole army shined as it were all in flames. But in the concave part of this Dart there was glue and fuel, for fire not to be extinguished, of Colophonia, Brimstone, and Saltpeter, all mingled with Oil of Bays. Others say, with Oil of Peter, Duck's grease, and Pith of the Reed of Ferula, Brimstone, and as others think, with Oil, Tallow, Colophonia, Camphire, Rosin, Tow. The old warriors called this an incendiary composition. Lucan speaks of burning ships:

This plague to water is not consonant,

For burning Torches, Oil and brimstone joined,

Are cast abroad, and fuel was not scant.

The Ships do burn with Pitch or Wax combined.

And elsewhere,

He bids them shoot their Shafts into the Sails,

Besmear'd with Pitch, and so he soon prevails.

The Fire straight does burn what's made of Flax,

And so their decks were fired by melting Wax,

And tops of Masts were burnt, and Seamen's packs.

But in compositions for Arrows and Darts that they might burn the more vehemently, they put melted Vernish, Printer's Oil, Petroleum, Turpentine, made up with the sharpest Vinegar, pressed close, and dried at the Sun, and wrapped over with Tow, and with sharp Irons to defend it, wrought together like to a bottom of Yarn. All which at last, only passing over one hole, are smeared over with Colophonia and Brimstone, after the manner that follows. But the subtilty of the Greeks, there was invented,

"A fire, called the Greek Fire."

To overcome the ship presently, they boiled Willow coals, Salt, spirit of wine, Brimstone, pitch, with the yarn of the soft wool of Ethiopia, and Camphire, which, it is wonderful to speak, will burn alone in the water, consuming all matter. Callimachus, the Architect, flying from Heliopolis, taught the Romans that thing first, and many of their emperors did use that against their enemies afterwards. Leo the Emperor, burnt with this kind of fire those of the East, that sailed against Constantinople with 1800 Carvels. The same emperor, shortly after, burnt with the same fire 4000 ships of the enemy, and 350 in like manner. Prometheus found out, that fire would keep a year in the cane Ferula. Wherefore Martial speaks of them thus;

Canes that the Masters love, but Boys do hate,

Are by Prometheus gift held at great rate.

Chapter III

"Of the diverse compositions of Gunpowder."

We should be ill spoken of, if, that treating of fiery compositions, we should not first say something of that wonderful Gunpowder, that is the author of so many wonderful things. For it is an ingredient in all mixtures, and all depends upon it. Not that I have any mind to speak of it, because it is so common, but of such things that have some new or hidden secret in them. It is made of four parts of Saltpeter, Brimstone and Willow coals, each of one part. But the Saltpeter must be refined from common Salt, the fat and earthy parts. For that is the foundation and basis of the rest. All of these must be well powdered and finely seiced, and perfectly mingled together. Therefore if you would have,

" Gunpowder that shall make a great noise, and do much service,"

Put in more parts of Saltpeter , namely, to one part of Brimstone, and one of Willow coal, put in six or eight parts of Saltpeter,

but excellent well refined and mingled. For four parts of Saltpeter well refined and mingled, will do more then ten parts of that which is faeculent, and ill mingled. From the Saltpeter comes the force, the noise of the flame, for Brimstone it takes fire, and the sooner for the coal. But if one would have,

"Gunpowder that will shoot a Bullet without noise,"

He must make weak the Saltpeter, but with some fat substance; which is done by the Glew and Butter of Gold, by mingling them according to a certain and due proportion; and so it will shoot a ball with very little or no noise; for you shall scarce hear it. And though the force be not so strong, yet it is but little less. I will not teach the way, lest wicked men should take occasion to do mischief by it.

Chapter IV

"How Pipes may be made to cast out Fire."

The same Heron bids the soldiers when they scale the walls, that they should set against the faces of their enemies that defend the cities, such handGuns that they can turn, and that will throw fire a great way. For so they shall so terrify those that defend the walls, by these monstrous engines that cast fireballs at such great distance, and with such furious flames, that they will never endure to behold them, nor yet the soldiers that mount up the walls, but will quickly run away. Moreover, in fights at sea, and among horsemen, men of this later age make great use of them, and break ranks. When Antipater besieged the Megarenses, and the Macedonians did fiercely lie upon them, the Megarenses first anointed their hogs with Pitch, and set them on fire, and so sent them out among their enemies. The Hogs were mad at it, and ran furiously among the troops of Elephants, and cried as they burned with the fire, and, as so many furies, they extremely disordered the Elephants. But I shall describe,

"Rockets that cast fire a great way."

Make a stick of three foot long, round on the outside, and with a Turners Instrument make it hollow within. Let the hole in the middle be four fingers diameter, and the wood a finger thick. But within let it be fenced with a thin Iron plate, and without with Iron hoops, at the mouth, in the middle, and on the end, and let the spaces between be fastened and joined together with Iron wires, lest by the violence of the flames, striving within, the engine should break in pieces, and hurt our friends. Fill the hollow hole with this composition. Gunpowder three parts, Colophonia, Tutia, Brimstone, half a part. But you must bruise your Brimstone and Colophonia very well, and sprinkle them with Linseed Oil, and work them in your hands. Then try if your mixture will burn gently or fiercely. Fill the space that between the joints in a reed with powder, put fire to it. If it burn vehemently, put more powder into your Rocket, pressing it again with a sharp stick. Then stop the mouth of it, being full, with a Linen Clout, Wax and Pitch, and cover it, that the powder will not fall out. And making a hole in the Clout, fasten a Cotton Match to the mixture, that when necessity is, it may take fire. You shall learn shortly after to make the Match. This is called a simple Rocket.

"How to make a Rocket armed."

This by a continual sending forth of Fireballs and leaden Bullets, an by the shooting off of Iron Guns, will strike through the faces of those that stand by. It is made of Turpentine, Rosin, liquid Pitch, Vernish, Frankincense and Camphire, equal parts; quick Brimstone a third part and half; two parts of Saltpeter refined, three parts of Aqua Fortis, as much of Oil of Peter and Gunpowder . Pound them together, and make Fireballs. Put them into the hollow of the pipe, that is broad enough to receive them. Put into the hollow part the first mixture, three fingers deep and press down. Then put in the little ball of Gunpowder only, weighing one ounce, ready made. Then put in again the first powder. And do this by course one after another, till it be

full, and stop the mouth, as I said. Some do not thrust down a ball, but Hards wrapped up in square pieces of Iron, and that is so pliable, the the first mixture can kindle the Gunpowder. Some put in with Tow, Glass grossly powdered. Others, Salt and powder of Lead. For if the lumps stick to armor or garments, you cannot put them out with water or any thing else till they become consumed. Some there are also that compass in the Rocket. with Brass or Iron Guns, and at the open passage of the Rocket, they put in Gunpowder. When fire comes at it, with terrible and frequent noises, they cast leaden Bullets forth upon the standers by. I saw a Rocket of extraordinary largeness. It was ten foot long, and as wide as a man's head might go in. It was full of Fireballs, stones, and other matters, and put into a Gun, and bound to the lower part of the crossyard of a ship, which was transported every way with cords, as the soldiers would have it. And in seafights was levelled against the enemies's Galleys, and destroyed them all almost. Yet I will not omit to relate how,

"A Brass Gun once fired, may discharge ten times."

It is a new invention, that Brass Gun, or a hand Gun, may discharge ten or more Bullets one after another without intermission. Make a dark powder, such as I used in the precedent part, and fill it thus; First, put in a certain measure of Gunpowder, that being put in, may discharge the ball. Then put in the ball, but a small one, that it may go in loosely, and that the powder put in upon it, may come to touch the Gunpowder. Then pour in this dark powder two or three fingers deep. Then put in your Gunpowder and one Bullet thus in order, one after the other, until the Gun seems to be full to the very mouth. Lastly, pour in some of your dark clammy powder. And when you have leveled your Gun to the place appointed, put fire to the mouth of it, for it will cast out the Bullets, and then fire for so long time as a man may discharge a handgun at diverse shoots. And thus with one Brass Gun you may discharge many times.

Chapter V

"How Fireballs are made that are shot off in Brass Guns."

Now I will show how to make some pot compositions of Fireballs that are shot out of Brass Guns, for diverse uses. Either to burn ships, or to give light to some men in the night, or at solemnities to cast up in the air, that they may seem to stream along like falling stars.

"Fireballs flying in the air."

That are made at festival times. Grind one pound of Gunpowder, one third part of Saltpeter, two ounces of Brimstone, and as much Colophonia. Mingle all these. Sew them up in Coffins made of thick cloth in the fashion of balls, and put them into hollow half circles made of wood, and strike them with a wooden hammer that they may be hard as stones. Then bind them about with cords, and dip them in Tar three or four times, that they may be well fenced about, lest being discharged by the violence of a Brass Cannon, they should break in pieces. Lastly, pierce them thrice through with a sharp stick in the center, and fill them with Gunpowder, and dry them to be sent aloft. When you would use them, raise your Brass Guns, or more conveniently the but end of your Guns, and take the ball in a pair of Iron pinchers, and give fire to the holes, that it may take. When you are certain that it is lighted, with your right hand cast it into the hollow of the Gun, and with your left, give fire to the lowest touch hole of the Gun. When it is fired, it rebounds, and being carried up by the force of the fire, it seems to run up and down in the air, as I often saw it in Rome, and prepared it. They are made also,

"Another way,"

Take five parts of Gunpowder, three of Saltpeter refined, Brimstone, two, Colophonia one half part, beaten Glass, common

Salt, or Oil of Peter, and of Linseed Oil, and refined Aqua Vita as much. Powder what must be powdered, and pass it through a fine Sieve. then melt it in a new earthen pot with burning coals, without flame. Let them not sparkle, for so many compositions may take fire. Then cast in the powders, that they may incorporate will together. Then make, round Coffins of Linen cloth as I said, and fill them with the Gunpowder alone, and bind them with cords about. Then wrap your Tow in the composition, and make a ball of the bigness you would have it. And if you will shoot it out of a Brass Gun, bind it the thicker with a little cord. Then pierce your ball through in many places with wooden picks, that they may come at the powder that lies in the middle. Then put a Cotton Match through, and when it flies in the air so violently, they may preserve the fire. In another earthen pot, melt Pine tree Gum, Gunpowder and Brimstone, and dip in your ball into that Liquor, that it may be overcast with it. When you take it out, lift up your Cotton Matches with a stick, and strew them with Gunpowder. This ball will sorely punish the enemies with a great noise, cracking and breaking asunder. The fire cannot be put out. It will burn all kinds of furniture, garments and what else, till it all be consumed. It will burn armor mightily, that unless they be taken off, they will burn the man.

Chapter VI

"Of Compositions with burning Waters."

Philosophers seeking the reason of waters that lie hid above and under the earth, and are always hot, they say, Bitumen is the cause thereof, which being once on fire, has this property, that it will not only not be put out, but if you cast on water it will burn the more. The mountain Chimaera burns always in Phaselis, both night and day. Gnidius Ctefias says, the fire of it is kindled by water, and is put out with earth or hay. In the same Lycia, Vulcan's mountains, touched with a burning torch, will so burn, that the very stones and sand in rivers are consumed by them, and will burn in the midst of the waters, and that fire is maintained by water. The hollow cave in Nymphaeum foreshows terrible things to the men of Apollonia. As Theopompus writes, it increases by shower, and it casts forth Bitumen, that must be tempered with that fountain that cannot be rafted, otherwise it is more weak then any Bitumen is. Now I shall search out the kinds of Bitumen. The first kind is liquid, called Naphtha, we call it Oil of Peter, which remains in stones and Kitram. This has a great affinity with fire, and the fire will take hold of it every way at a great distance. So some say, that Medea burned a Whore, who, when she came to sacrifice at the altar, the fire laid hold on her garland. Another kind is, that men call Maltha. For in the city of Comagenes Samosata, there is a lake that sends forth burning mud. When any solid thing touches it, it will stick to it, and being touched, it will follow him that runs from it. So they defended the walls, when Lucullus besieged them, and the soldier burned in his armor. Waters do kindle it, and only earth can quench it, as experience shows. Camphire is a kind of it. As Bitumen, it draws fire to it and burns. Pissphaltum is harder then Bitumen. Both Amber and Jet are of this sort, but these burn more gently, and not so much in the waters. Moreover, in regard it burns in the water, it is Bitumen, for no fatter thing is dug forth of the earth. To maintain this fire, itself is sufficient. It neither burns in the waters, nor is it put out with water, nor does it last long. But joined with Bitumen, the fire will last always, as we see in the Phlegrean mountains at Puteoli. And as fire, if Oil be cast in, burns the more. So when Bitumen is kindled, water cast on, makes the flame the greater. Wherefore I shall make use of those fires that burn in and above the waters. But I shall bring some examples how it is made.

"A Ball that will burn under Water."

First prepare your Gunpowder. For this must be one ingredient in all compositions, and gives force to the rest to burn vehemently. If it be in great corns, pound it well, and Seirce it fine. To seven parts of this, add two parts of Colophonia, three of Saltpeter, one of Brimstone. Pound them all together, and mingle them, sprinkling on of Naphtha,, or of liquid pitch Kitram. Moistening them so long, until the powder pressed in your hand will stay together. When these are well mingled, make trial by them. If it burns too vehemently, add more Colophonia, Saltpeter and Brimstone. But if but weakly, more Gunpowder. This mixture must be wrapped in straw or linen rags, or put into Coffins made of the same things, and bind it as close as you can

with straw, little cords round about. Then dip it into scalding pitch, and so let it dry. Then wrap it again with straw, and smear it over with pitch, to keep it safe from water, and that it may not break asunder by the violence of the fire. When it is well dried, and a little hole made in it, put in Gunpowder, and put fire to it. And when it begins to burn, stay very little, and cast it into the water. It will by its weight fall to the bottom, and the flames will strive with the water, and drive them far from it. So it will appear to burn above, and is obscured with a black smoke, that you will think you see sulphurous waters of Puteoli burning there. Being then made lighter by many turnings and windings, it will seem to ascend to the superficies of the water, which is a most pleasant sight. For you will think that the water burns, and you will see two contrary elements fighting together, yet to unite friendly until the matter be spent. Others wrap in cloth nothing but Gunpowder a whole handful, and this they bind in with cords. Then they dip it in melted scalding pitch, and bound very fast, and wrapt in many linen rags. They make a small hole through it, and they place this in the center of the ball we even now speak of, that when it comes to the superficies of the water, the fire taking hold on the powder within, breaks the ball in pieces, and with mighty noise, wounds all those that stand near it. Some make it,

"Otherwise."

The make a composition of Colophonia, Saltpeter and Brimstone, Vernish and to this they add a fourth part of Gunpowder, and they add Turpentine rosin, Oil of liquid Vernish, Petroleum, Linseed Oil, and the best Aqua Vita. With these they wet and sprinkle the dry powders. I have seen this take fore more vehemently, and to cast the flames farther. To do,

"The Same,"

Take Mastick one part, Frankincense two, grains of Vernish, Brimstone, Camphire, Gunpowder, of each three parts, of Colophonia six, Saltpeter refined nine. Pound them all together, and sift them. Only pound the Camphire mingled with the salt, for that only will not be powdered. Strew them all about upon an earthen dish with a large mouth, and sprinkle them with Naphtha, or Vernish, or Linseed oil, and mingle them with your hands. Take out part of the powder, and put it in a hollow cane, and try it, whether it will burn to your mind. And if burns too weak, put in more Gunpowder. If too vehemently, more Colophonia. Always trying if it be as it should be. for to these compositions, we add the same things to blunt vehement burning of the Saltpeter and the Gunpowder. Then make Coffins of canvas, like balls, and fill them with your composition, and stuff it in well, and bind them will with cords round about. Then melt Brimstone, and let there be in it one fourth part of Gunpowder. Stir them together with a wooden stick, and lute the ball over with that liquor, that it may be well fenced and crusted. Then with a wooden pick make a hole in it in the middle to the center, and fill that with powder, an so put in fire, and it will burn under water. It may also be shot forth of Brass engines. I will show you how to make,

"Balls and pots to be cast forth of Ships,"

The Ancients write, that Alexander the Great found out this composition of fires, to burn bridges, gates, ships, and the like. But it will work now more vehemently, by the reason of the Gunpowder added. Take Gunpowder, Saltpeter, Brimstone, Pitch, Pine tree gum, Vernish in grains, Frankincense, of each like. Camphire one half. Beat all these, and mingle them. Then take Oil of Peter, liquid Vernish, Rosinous Turpentine, equal parts, and with these, being liquid, mingle all together, and fill pots with them, to be cast among ships and enemies. Or, if you make a ball of these, bind it hard about the bead of a hammer, whose sharp toothed end must be a foot long, and the handle three foot. If at a seafight, any one with a light boat strike this into a ship of enemies with one blow, he shall raise a mighty fire, that neither water nor any other thing will put out.

"How Balls are made of Metals that will cast forth fire and Iron wedges."

I will show you how to make brittle balls of metal, that being filled with Gunpowder, and all the places of vent stopped, with the violence of the flame will fly into many pieces, and strike through those they meet with, and on all sides they will pierce through those who are not only unarmed but armed men. And these are to be used in besieging of cities. For cast among multitudes, they will wound abundance. The danger is seen among herds of cattle. Make then,

"Balls that will cast pieces of Iron a great way off."

Let a ball of metal be made a handbreadth in diameter, half a finger thick. The metal is made of Brass three parts, Tin one part, to make it brittle, that by force of fire it may fly in small pieces. To make the ball more easily, make it of two half circles, for the charge is less, and let them join together like a box, or let them screw one within another. Let it be equally thick, that it may break in all parts alike. Then with a nail drove through the middle, let it be fastened the better together, a finger thick, that it may break in all parts before it do in the joints. Then make a little pipe as big as a finger, and as long as ones hand, that it may come to the center of the ball, and so stick forth beyond the superficies, like a pyramis, the basis outward, the point inward. Solder it fast to the ball. The nail, as I said, must come forth on both sides, and to this fasten wires, that runs through Iron piles, that have a large hole through them, that every wire may have thirty of them, that when the ball is broken by force of the fire, the wires of Iron may break also, and the piles of Iron may be thrown about, a great way, with such force, that they may seem to be shot forth of Guns and ordnance. Lastly, let the ball be filled with the best Gunpowder only, but the pipe with that mixture that burns more gently, that when fire is put to it, you may hold it so long in your hand, until that slow composition may come to the center, and then throw it among your enemies, for it will break in a thousand pieces, and the Iron wires and pieces of Iron, and parts of the ball will fly far, and strike so violently, that they will go into planks or a wall a hand depth. These are cast in by soldiers, when cities are besieged, for one may wound two-hundred men. And then it is worse to wound then to kill them, as the experience of war shows. But when you will fill the pipes, hold one in your hand without a ball, full of composition, and try it how long it will burn, that you may learn to know the time to cast them, lest you kill yourself and your friends. I shall teach you how with the same balls,

"Troops of horsemen may be put into confusion."

There are made some of these sorts of balls that are greater, about a foot in bigness, bound with the same wire, but fuller of Iron piles, namely with a thousand of them. These are cast among troops of horsemen, or into cities besieged, or into ships with slings, or Iron Guns, which they call Petrels, and diverse ways. For if they be armed with Iron pieces, when they break they are cast forth so with the violence of the fire, that they will strike through armed men and horses, and so fright the horses with a great noise, that they cannot be ruled by bridle or spurs, but will break their ranks. They have four holes made through them, and they are filled with this said mixture, that being fired they may be cast among troops of horsemen, and they will cast their flames so far with a noise and cracking, that the flames will seem like to thunder and lightning.

Chapter VIII

"How in plain ground, and under waters, mines may be presently dug."

To dig Mines to overthrow cities and forts, there is required great cost, time, and pains, and they can hardly be made but the enemy will discover it. I shall show how to make them in that champion ground, where both armies are to meet, with little labor, and in short time.

"To make Mines in plain grounds where Armies are to meet."

If you would do this in sight of the enemy (for they know not what you do) I shall first teach how. A little before night, or in the twilight, where the meeting shall be, or passage, or standing, there may pits be made of three foot depth, and the one pit may be distant from the other about ten foot. There sit your balls about a foot in bigness, that you may fill the whole plain with them, then dig trenches from one to another, that through them Cotton Matches may pass well through earthen pipes, or hollow Canes, but fire the balls at three or four places. Then bury them, and make the ground even, leaving a space to give fore to them all at once. Then at the time of war, when the enemy stands upon the ground, then remove at your pleasure, or counterfeit that you flee from them, and cast in fire at the open place, and the whole ground will presently burn with fire, and make a cruel and terrible slaughter among them. For you shall see their limbs fly into the air, and others fall dead pierced through, burnt with the horrible flames thereof, that scarce one man shall escape. You shall make your Match thus. In a new test let the best Aqua Vita boil with Gunpowder, till it grows thick, and be like Pap. Put your Matches into it, and roll them in the mixture. Take the test from the fire, and strew on as much Gunpowder as they will receive, and set them to dry in the Sun. Put this into a hollow Cane, and fill it full of Gunpowder. Or take one part refined Saltpeter, Brimstone half as much, and let it boil in a new earthen pot, with Oil of Linseed. Put in your Match, and wet them well all over with that Liquor, take them away and dry them in the Sun. But if you make,

"Mines under the Water,"

Use this rare invention. You shall make your Mines where the enemy Galleys or ships come to ride, you shall upon a plain place fit many beams, or pieces of timber, fastened cross-wise, and thrust through. Or like nets, according to the quantity in the divisions, you shall make fit circles of wood, and fasten them, and fill them with Gunpowder, the beams must be made hollow, and be filled with Match and powder, that you may set fire to the round circles. With great diligence and cunning, smear over the circles and the beams with Pitch, and cover them well with it, that the water may not enter, and the powder take wet (and so your labor will be lost) and you must leave a place to put fire in, then sink your engine with weights to the bottom of the water, and cover it with stones, and mud and weeds, a little before the enemy come. Let a scout keep watch, that when their ships or Galleys ride over the place, that the snare is laid, for fire being put to it, the sea will part, and be cast up into the air, and drowned the ships, or will tear them in a thousand places, that there is nothing more wonderful to be seen or done. I have tried this in waters and ponds, and it performed more then I imagined it would.

Chapter IX

"What things are good to extinguish the fire."

I have spoken of kindling fires, but now I shall show how to quench them, and by the way, what things obnoxious to the fire, will endure it and remain. But first I will relate what our ancestors have left concerning this business. Vitruvius says, that the Larch tree wood will not burn, or kindle by itself, but like a stone in the furnace, will make no coals, but burn very slowly. He says the reason is, that there is in it very little air or fire, but much water and earth, and that it is very solid, and has no pores that the fire can enter at. He relates how this is known. When Caesar commanded the citizens about the Alps, to bring him in provision, those that were secure in a castle of wood, refused to obey his commands. Caesar bade, make bundles of wood, and to light torches, and lay these to the castle. When the matter took fire, the flame flew exceeding high, and he supposed the castle would have fallen down. But when all was burnt, the castle was not touched. Whence, Pliny writes, the Larch tree will neither burn to coals, nor is otherwise consumed by fire, then stones are. But this is mostly false. For seeing it is rosinny and oily, it presently takes fire and burns, and being once fired is hard to put out. Wherefore I admire, that this error should spread so far, and that the town Larignum, so called from the abundance of Larch wood, compassed about with fire, should suffer no hurt. Moreover, I read that liquid Alom, as the Ancients report, will stand out against fire. For wood smeared with Alom, and

Verdigrease, whether they be posts or beams, so they have a crust made about them, will not burn with fire. Archelaus the General, for Mithridates made trial of it in a wooden tower against Sylla, which he attempted in vain to set on fire. Which I find observed by Quadrigarius, in his Annals. But this liquid Alom is yet unknown to many learned men. Our Alum wants this property. But many say, that Vinegar prevails against fire. Plutarch says, that nothing will sooner quench fire then Vinegar of all things, it most puts out the flame, by its extremity of cold. Polianus reports, Athenales, when he was besieged by his enemies, poured out of brazen vessels, melted Lead upon the engines, that were set to scale the place, and by this were the engines dissolved, but the enemies poured Vinegar upon it, and by that they quenched the Lead, and all things else that fell from the walls. And so they found Vinegar to be the fittest to quench fire, and an excellent experiment, if things be wet with it. Pliny praises the white of an Egg to quench it, saying, that the white of an Egg is so strong, that if wood be wet with it, it will not burn, nor yet any garment. Hieron, to cover scaling engines, used the raw hides of beasts new killed, as having force to resist fire. And the joints of wood they fenced with Chalk, or with ashes tempered with blood, or clay molded with hair or Straw, and with Seaweed wet with Vinegar, for so they were safe from fire. Carchedonius was the first that taught men to cover engines and rams with green hides. I have heard by men of credit, that when houses were on fire, by a peculiar property, the menstruous clothes of a woman that had her courses the first time, cast over the planks, would presently put out the fire. Thick and muscilaginous juices are good against fire, as of Marsh Mallows. Therefore Albertus wrote, not very absurdly, the white of an Egg and Vinegar, with Alom ,

"He may handle fire without hurt."

And it is a thing that has much truth to it. But I think that Quicksilver killed in Vinegar, and the white of an Egg, and smeared on, can preserve anything from fire.

Chapter X

"Of diverse compositions for fire."

I shall speak of diverse compositions for fire to be used for diverse uses. But men say M. Gracchus was the author of this invention.

"To make a fiery composition, that the Sun may kindle."

It consists of these things. Oil of rosinous Turpentine, of Quicksilver (otherwise then I showed in Distilling) of Juniper, of Naphtha, Linseed, Colophonia, Camphire. Let there be Pitch, Saltpeter, and Duck's grease, double to them all. Aqua Vita refined from all flegm. Pound them all, and mingle them. Put them up in a glazed vessel, and let them ferment two months in horse dung, always renewing the dung, and mingling them together. After the set time, put it into a Retort, and Distil it. Thicken the Liquor either with Pigeon's Dung, finely sifted, or with Gunpowder, that it may be like Pap. Wood that is smeared over with this mixture, and set in the summer sun, will fire of itself. Pigeon's Dung easily takes fire by the Sun beams. Galen reports, that in Mysia, a part of Asia, a house was so set on fire. Pigeon's Dung was cast forth, and touched a window that was near. As it came to touch the wood that was newly smeared with Rosin, when it was corrupted, and grew hot, and vaped in the the midsummer, by heat of the Sun, it fired the Rosin, and the window, then other places smeared with Rosin, took fire, and by degrees part of the house began to take hold, and when once the covering of house began to flame, it soon laid hold of the whole house, because it has a mighty force to inflame all. Duck's grease is very prevalent in fireworks, and physicians praise it extremely, that it is most subtle, penetrating and hot, it makes other things penetrate, and as it is most subtle and hot, so it takes fire vehemently, and burns. I shall show how to Distil,

"A most scalding Oil."

When I would prepare the most excellent compositions of burning Oil, I Distilled common Oil in a Retort, but with great labor. Yet what was Distilled was thin, combustible, and ready to fire, that once kindled, it was not to be put out, and it would draw the flame at a great distance, and hardly let it go. But Oil of Linseed is stronger than it. For if you Distill it often, it will have such a wonderful force to take fire, that it can hardly be shut up in a vessel, but it will draw the fire to it. And the glass being opened, it is so thin, that it will fly into the air, and if the light of a candle, or of fire touch it, the air takes fire, and the Oil fired by it, will cast the flame afar off, so vehemently, that it is almost impossible to quench it. It must be distilled with great cunning, let the vessel overheat, it should take fire within. Moreover,

"Fire that is quenched with Oil, is kindled with water."

It is thus made. I said that Naphtha will burn in water, and that Camphire is a kind of it. Wherefore, if you mingle Brimstone with it, or other things, that will retain fire. If you cast in Oil or mud, it will quench it. But it revives and flames more, if you cast in water. Livy relates, that some old women in their plays, lighting torches made of these things, passed over Tyber, that it seemed a miracle to the beholders. I said it was the property of Bitumen to take fire from water, and to be quenched with Oil. Dioscorides says, that the Thracian Stone is bred in a certain river of Scythia, the name of it is Pontus. It has the force of Jet, they say it is inflamed by water, and quenched with Oil, like as Bitumen. Nicander speaks of this stone thus,

If that the Thracian Stone be burnt in fire,

And wet with water, the flame will aspire,

But oil will quench it. Thracian Shepherds bring

This stone from the River Pontus, Poets sing.

"Torches that will not be put out by the winds."

They are made with Brimstone, for that is hardly put out, if once kindled. Wherefore torches made with Wax and Brimstone, may be carried safely through winds and tempests. These are good for armies to march by, or for other necessary things. Others use such; they boil the wick of the torches in Saltpeter and water. When it is dried, they wet them with Brimstone and Aqua Vita. Of this mixture then they make their candles, with Brimstone, and then with half Camphire, and Turpentine, two parts Colophonia, three of Wax, of this they make four candles, and put them together. In the middle that is empty, they cast in quick Brimstone, and they will forcibly resist all things. Or thus. Boil wicks of Hemp or Cotton in water, with Saltpeter. Take them out and dry them. Then melt in a Brass pot equal parts of Brimstone, Gunpowder, and Wax. When they are melted, put in your wicks to drink up part of the mixture. Take them out, and to what is left in the kettle, add Gunpowder, Brimstone, and Turpentine, of each a like quantity, of which mixture make our torches, and join them together. Also there is made,

"A cord that set on fire, shall neither smoke nor smell."

When soldiers or hunters go secretly by day or night, they use sometimes to make a Match, that being lighted, will neither smell near hand, nor far off, nor make any smoke. For wild beasts, if the Match smell, will scent it, and run to the tops of the mountains. Take a new earthen pot, and put into it a new cord so handsomely, that the whole pot may be filled, so laid in rounds, that no more can go in, cover it, and lute it well three or four times, that it may have no vent, for the whole business depends on this. Then make a fire round about it, by degrees, that first it may grow hot, then very hot, and lastly red hot. And if sometimes the smoke come forth, stop the chinks with Clay still. Then heaped up under the coals, let it grow cold of itself, and opening the pot, you shall find the cord black, like coal. Light this cord, and it will neither smoke nor smell.

Chapter XI

"Fire-compositions for festival days."

I have shown you terrible and monstrous Fireworks. It is fit to show you some to use a solemn times. Not so much for use, as to give you occasion to find out higher matters. I shall show then how to make one,

"That when a man comes into his chamber, the whole air may take fire."

Take a great quantity of the best refined Aqua vita, and put Camphire into it, cut small, for it will soon dissolve in it. When it is dissolved, shut the windows and the chamber doors, that the vapor that exhales, may not get forth. When the vessel is full with water, let it boil with coals, put under, without any flame, that all the water may resolve into smoke, and fill the chamber. And it will be so thin, that you scarce perceive it. Let some man enter into the chamber with a lighted candle in his hand, and the air by the candle light, will take fire all about. And the whole chamber will be in a flame, like an oven, and will much terrify one that goes in. If you dissolve in the water a little Musk, or Amber-greese, after the flame you shall smell a curious scent. Also there is made,

"Exceeding burning water."

Thus: Take old strong black Wine. Put into it Quicklime, Tartar, Salt, and quick Brimstone. Draw out the water of them with a glass Retort. This will burn exceedingly and never cease till it is all consumed. If you put it into a vessel with a very large mouth, and put flame near it, it will presently take fire. If when it is on fire, you cast it against a wall, or by night out at the window, you shall see the air full of sparks, and kindled with fires. It will burn, held in your hands, and yet will not scald you. Distil it once again, and it will burn the less. But if you take equal parts of Quicklime, and Salt, and shall mingle them with common Oil. And make little balls, and cast them into the belly of the Retort by the neck. And then shall draw forth the Oil by a vehement fire. And mingling this Oil again with Salt and Quicklime. Shall Distil them again. And shall do the same four times. An Oil will come forth that will burn wonderfully, that some deservedly call it Infernal Oil. A solemn pleasant fire, is made for the theater. If Camphire be dissolved in Aqua vita, and with that Fillets, paper, or parchments, be smeared. And being dried again, be lighted. And fall from a loft, as they fall lighted through the air, you shall see Serpents with great delight. But if you desire,

"To cast flame a great way,"

Do thus: Beat Colophonia, Frankincense, or Amber finely. And hold them in the palm of your hand, and put a lighted candle between your fingers. And as you throw the powder into the air, let it pass through the flame of the candle. For the same will fly up high. If you will have that,

"Many candles shall be lighted presently."

On festival days, as I hear they are wont to do among the Turks. You shall boil Brimstone and Orpiment with Oil, and in them let thread boil. When it is dry, bind it to the wicks of candles, and let them pass through. For when one head is lighted, the flame will run to them all, and set them on fire. Some call it Hermes, his ointment. Any man may,

"Eating in the dark, and sparkles out of his mouth."

It is pleasant for the spectators. And it is thus. Let a man eat Sugar Candy, for as he breaks it with his teeth, sparkles will seem to fly out of his mouth, as if one should rub a Firebrand.

Chapter XII

"Of Some Experiments of Fires."

I will set down some experiments, that are without the ranks of the rest. I held it better to conceal them. But they may give you occasion to think on greater matters by them. If you will,

"That Bullets from Brass Guns, may enter deeper."

You may easily try this against a wall, or plank set up. Let the ball rather go into the hollow of it, slight, then wide. But wet it with Oil before you put it in. And so cast it in. This Bullet shot off by force of fire, will go in twice as far as otherwise. The reason is easy. For the Oil takes away the occasion of the airs breathing forth. For all bents being stopped, the flames striving within, cast forth the Bullet with more violence, as we shall show more at large. So also will the Bullets of Brass Guns penetrate with more force. And if you Lard the Bullets, they will penetrate through arms of proof. I can also by a cunning artifice,

"Shoot a man through with a Bullet, and no place shall be sent where it went in, or came forth."

The mind of a man is so cunning, that it has invented a way to shoot a man quite through with a Bullet, and yet no mark of the Bullet shall appear, though all the inward parts be bruised and beaten through. Consider, that what things are heavy, are solid, and so subtle, that they will be penetrated and leave no marks where they entered or came out. And they will do the same, though they be united, as if they were disjointed. And every part will act by itself alone, as it would do being united. I have said thus, to take away all occasions from ignorant and wicked people, to do mischief. I saw,

"A Gun discharge often, and yet no more powder was put in."

Famous soldiers use this, not only for Brass Cannon, but for small handguns. It is thus: Wrap a paper three or four times about the Rammer that is put into the hollow mouth of the Gun, and drawing out the Gunstick. Fill that hollow place with powder and Bullet. Here and there let the Bullets be stopped in, and glued fast, that no sicissure or vent may appear in the paper. First, let it be put into the Gun, but loosely, that the powder put in above, may come to the vent hole beneath. Then put your measure of powder in atop, and stamp in your Bullet. Putting Gunpowder to the Touch-hole. And putting fire to it, the upper ball shall be shot off with its powder. Presently thrust in a sharp instrument at the vent hole, and make a hole in the Cartridge, and feed it with powder, and put fire to it again. And in a short time it will discharge twice. I can,

"Blind your eyes with the smoke."

This may much profit, when enemies come to storm the city. But first we must consider the wind, that it may be at the backs of our men, and may carry the smoke into the faces of our enemies. Let there be measure made like Lanthorns, so that they may go in at the mouths of the Brass Guns. Fill them with powder of Euphorbium, Pepper, Quicklime, Vine ashes, and Arsnick Sublimate. And put them into the hollow of it, after the Gunpowder. For by force of fire, will these paper frames break. And the smoke of the powder, if it comes at the eyes of the enemy, will so trouble them, that casting away their weapons, they can hardly save their eyes.

Chapter XIII

"How it may be, that a candle shall burn continually."

Before we end this book, I shall discover, whether it may be that a candle once lighted, should never be put out. Which seems very contrary to the reason of the corruptible things of this world, and to be past belief. But let us see first whether the Ancients ever attempted it, or did it. We read in the roman histories, that there was at Rome, in the temple of the goddess Vesta, and of Minerva, at Athens, and of Apollo, at Delphi, a perpetual fire kindled. But this seems to be false. For I remember that I have read in many authors, that this Perpetual Fire was always kept so by the Vestal Nuns, that it should never go out. As we find it in Plutarch, in the Life of Numa. And then in the time of the civil war, and of Mithridates, it went out. At Delphi it was watched by widows, who took care, by always pouring in of Oil, that it should never go forth. But this failed, when the Medes burnt that temple. Of the same sort was that fire, God appointed by Moses in the scriptures. The fire shall always burn upon mine altar, which the priest shall always keep lighted, putting under wood day by day. Wherefore, the fire was not perpetual in the temples of the gods of the Gentiles. Yet I read about the town Ateste near Padua, there was found an earthen pitcher, in which there was another little pitcher, and in that there was found a little light still burning. Which by the hands of some ignorant fellows, pouring it rudely forth, was broken. And so the flame was put out. And in our time, about the year 600, in the island Nesis, that stands in Naples, there was a Marble Sepulchre of some Roman found, and that being opened, a Vial was found with it, in which there was a candle. When this was broken, and it came to the light, it went out. It was shut in before the coming of our Savior. Some others I have heard of, by report of my friends, there were found and seen with their eyes. Whence I collect this may be done, and was done by our ancestors. Let us see if we can do the same. Some say that Oil of metals may last long, and almost perpetually. But this is false. For Oil of metals will not burn. Other say, Oil of Juniper from the wood will last long, because the coals of that wood may be kept a whole year alive under ashes. But this is most false, because I kept a coal under ashes, and it would not last two, nor yet one day. And the Oil of the wood burns most vehemently, and is sooner wasted away then common Oil. Some boast they have drawn Oil from the incombustible stone, thinking that flame cannot consume that. For a wick made thereof, will never be burnt. And yet burns always, if you put Oil always to it. But if that be true, that the wick is not consumed by fire, yet that follows not that Oil extracted from it, should burn always and never waste. And no man yet was ever seen to draw Oil from the stone Amiants that would burn. Others think that Oil drawn from common Salt, will last always. For if you cast Salt into Oil, it makes the Oil in the lamp last twice as long, and not be consumed, which I affirm to be true. Therefore if Oil be Distilled from it, it will burn always and never waste. Yet this follows not that Oil drawn from Salt will burn continually. And Oil Distilled from it will burn no more than a stone of Aqua fortis, that parts Gold and Silver, of which kind it is. But it is an ignorant thing to imagine, that an Oil may be made that shall burn always, and never consume. Wherefore some other thing must be thought on. Some say (and they do not think foolishly) that fire in a Vial does not always burn. But in the Vial there is some composition laid up, that so soon as it comes to air, presently takes fire, and seems to burn only at that time, yet it never burned before. This may be true. For as I often have labored in chemical matters, a glass well stopped, and forgot by me after the things were burned in it. And being left so for many months, I may say, many years. At last, being opened, has been seen to flame, and burn, and smoke. What I had burnt, I forgot, but they might be the same things, that I heard of by my friend, that had the same chance. For when he had boiled Litharge, Tartar, Quicklime, and Cinnaber in Vinegar, until it was all evaporated. And then covering and Luting the vessel well, he set it into a vehement fire. And when it was enough, he set it by till it was cold. After some months, when he went to open it to see his work, a flame suddenly flew out of the vessel, and set on fire some things, when as he thought of no such matter. And the the same has happened to many more. Moreover, when I boiled Linseed Oil for the press, when the flames took within, I covered the pot with clothes to put it out. After some time I opened the vessel, the Oil at the air coming to it flamed again, and took fire. But experience is against this opinion. For who saw a candle shut up close in a glass Vial, and to keep its flaming quality, and to give light? For the Ancients thought that the souls of the dead did always rest in the grave, as the ashes do. And that they might not lie in the dark, they endeavored all they could to send out this light. That their souls might enjoy light continually. Therefore we must think on another experiment, and make trial of it. But this must be held for a rare and firm principle in Nature's shop, that the cause of wonders is because there can be no Vacuum. And the frame of the work will

sooner break asunder, and all things run to nothing, then there can be any such thing. Wherefore if a flame were shut up in a glass, and all the vent holes stopped close, if it could last one moment, it would last continually. And it were not possible for it to be put out. There are many wonders declared in this book, and many more shall be set down, that have no other cause. But how the flame should be lighted within side. This is worth the while to know. It must be a Liquor or some subtle substance, and that will evaporate but little. And if then it can be shut up in the glass, when the glass is shut it will last always. Which may easily be performed by burning-glasses, fire, industry, and cunning. It cannot be extinguished, because the air can come in nowhere to fill up the emptiness of the Vial. The Oil is always turned into smoke, and this, being it cannot be dissolved into air. It turns to Oil and kindles again. And so it will always by course afford fuel for the light. You have heard the beginnings. Now search, labor and make trial.