Imprimatur.

G. Stradling Rever. in Christo
1662.
THE
Art of Glass,
WHEREIN
Are shown the ways to
make and colour Glass, Pastes, Enamels, Lakes, and other Curiosities.
Written in Italian by Antonio Neri, and
Translated into English, with some
Observations on the Author.

Whereunto is added an account of the
Glass Drops, made by the Royal Society,
meeting at Gresham College.

LONDON,
Printed by A.W. for Octavian Pulleyn, at
the Sign of the Rose in St. Paul's
Church-yard. MDCLXII.
THE A.RT OF GLA,D,
WHEREIN THE WATCHES TO
MAKE AND REPAIR GLASS COLOURED,
WITHE AND COLD AND OTHER GLASSES
WRITTEN IN ITALIAN BY A. M. A., AND
TRANSLATED INTO ENGLISH, WITH SOME
NOTES AND OBSERVATIONS OF THE AUTHOR.
WHEREAS IT was made by a Servant of the
CLERK DOCTOR C. P. R. R. S. to
THE USE OF GLASSMAKERS AND GLASSERS.

BENJAMIN" NOBLE.
To the most Illustrious and Excellent Lord Don Antonio Medici.

Antonio Neri.

Having taken much pains for many years from my youth about the Art of Glass, and having experimented therein, many true and marvellous conclusions, I have compiled a Treatise of them, with as much clearness as I could, to the end to publish it to the world, to please and delight (as much as in me a 3 (lay
The Epistle Dedicatory.

lay) men understanding in that profession, having found out many things by my own invention, and some others tried by able men, and found most true. I will make manifest those hidden Mysteries, for the reasons abovesaid. If I do attain this my intention it shall occasion me hereafter to be encouraged to publish the rest of my Labours about other Chymical and Physical matters, having likewise in both experimented, many most profitable, credible, and admirable Conclusions, for no other reason, but to understand them truly. I judge that I ought not to dedicate this Book to any other, but your Illustrious Excellence, who have been always my singular Protector, as also, because you are understanding of this, and of
The Epistle Dedicatory.

of whatsoever Noble and Precious knowledge, being exercised continually in all these Arts, which are required in a true and generous Prince; I beseech you then to accept, if not the work, yet my devout mind towards your great merit, and virtue of your most Illustrious Excellence, for whom I pray to God to prove on you all happiness.

From Florence,

6 Jan. 1611.
To the Curious Reader.

Here is no doubt that Glass is one of the true fruits of the Art of fire, since that it is very much like to all sorts of minerals and middle minerals although it be a compound and made by Art. It hath fusion in the fire, and permanence in it; likewise as the perfect and shining Metall of Gold, it is refined, and burnishèd, and made beautiful in the fire. It is manifest that it’s use in drinking vessels, and other things profitable for man’s service, is much more gentle, gracefull, and noble then any Metall or whatsoever stone fit to make such works, and which besides the easiness and little charge wherewith it is made, may be wrought in all places; it is more delightful polite and sightly, than any other material at this day known to the world. It is a thing profitable in the service of the Art of distilling, and Spagyrical, not to say necessary to prepare Medicines for man, which would be im-

\[\text{possible}\]
To the Curious Reader.

Possible to be made without the means of Glass, so that herewith are made so many sorts of Instruments, and Vessels, as Bodies, Heads, Receivers, Pelicans, Lutes, Retorts, Athenors, Serpentes, Vials, Cruces, square and round Vessels, Philosophical Eggs, Globes, and infinite other sorts of Vessels, which every day are invented to compose and make Elixars, Arcana, Quintessences, Salts, Sulphurs, Vitriols, Mercuries, Tinctures, separation of Elements, all Metalline things, and many others, which every day are found out; and besides there are made others for Aqua-fortis, and Aqua-regia, so necessary for Refiners, and Masters of Princes Mints, to Refine Gold and Silver, and to bring them to their perfection; indeed so many things profitable for man's use are made, that seem impossible to be made without the use of it: and the great Providence of God, is as well known, by this, as in every other thing, who hath made the matter of which Glass is compounded (a thing so needful and profitable to man) so a-boundling in every place and Region, which with much ease may be every where made. Glass is also a great ornament to the Churches of God, for herewith (besides many other things) are made so many beautiful Glass Vessels adorn'd.
To the Curious Reader.

adorn'd with fair Pictures, wherein the Metalline colours are in such sort advanced, and so lively, that they seem to be so many Oriental Gems, and in the Glass Furnaces, the Glass is coloured with so many colours, with so much beauty and perfection, that it seems no material on the earth can be found like it. The invention of Glass (if it may be credited) is most antient, for the holy Scripture in the Book of Job, Chap. 28. saith, Gold and Glass shall not be equal to it, &c. which gives clear testimony that Glass was antiently invented, for Saint Hierom saith, that Job descended from Abraham, and was the son of Zanech, who descended from Esau, and so was the fifth from Abraham himself; some will, and perhaps with some reason, that the invention of Glass was found out by the Alchymists; for they desiring to Imitate Jewels, found out Glass; a thing perhaps not far from truth; for as I shew clearly in the fifth Book of the present work, the manner of imitating all Jewels, in which way is seen the vitrification of stones which of themselves will never be melted nor vitrified. Pliny saith, that Glass was found by chance in Syria, at the mouth of the river Bellus, by certain Merchants driven thither by the fortune of the Sea,
To the Curious Reader.

Sea, and constrained to abide there, and to dress their provisions, by making fire upon the ground, where was great store of this sort of herb which many call Kali, the ashes whereof make Barillia, and Rochetta; This herb burned with fire, and therewith the ashes & Salt being united with sand or stones fit to be vitrified is made Glass: A thing that inlightens mans understanding, with the means, and manner of making not onely Glass, but Crystall and Crystalline, and so many other beautiful things which are made thereof. Many assert that in the time of Tiberius the Emperour was invented the way of making Glass malleable, a thing afterwards lost, and to this day wholly unknown, for if such a thing were now known without doubt it would be more esteemed for its beauty, and incorruptibility, than Silver and Gold; since from Glass there ariseth neither rust, nor tast, nor smell, nor any other quality; Moreover it brings to man great profit, In the use of prospective Glasses and Spheres.

And although one of them may be made of natural Crystall, called, that of the mountain, and the other with the mixture, called Steel, a composition made of Brass and Tin, notwithstanding in both, Glass is more profitable and
To the Curious Reader.

Of less charge, and more beautiful and of greater efficiency: especially in Spheres, which besides the difficulty, and expences in making them, they present not to the life as Glass doth, and which is worse, in a short time they grow pale, not representing any thing. Wherefore for these and many other reasons, you may well conclude, that Glass is one of the most Noble things which man hath at this day, for his use upon the earth. I having laboured a long time in the Art of Glass, and therein seen many things, I was moved to make known to the world a part of that which I had seen and wrought therein. And although the manner of making Salt, Lees, and Frittaes, is known to many, yet notwithstanding it seemed to me, that this matter requires to be handled (as I do) clearly and distinctly, with some Observations and diligence, which if well considered will not be judged altogether unprofitable; but perhaps necessary and known to few: besides in my particular way of extracting Salts, to make a most noble Crystall, that if the workman shall be diligent in making it, as I do publish and teach it, with clear demonstrations he shall do a thing as beautiful, and noble, as happily is made in these days, or can be done any other way; and in this thing, and in every other
To the Curious Reader.

matter that I treat of in this present work, the
diligent and curious operator shall find, that I
have wrote and shown truth, not told me, or
perswaded me by any person whatsoever, but
wrought and experimented many times with my
own hands, I having always had this aim to
write and speak the truth. And if any one try-
ing my receits, and manner of making colours,
Paste, and Tinctures, doth not speed to do so
much as I write thereof, let him not be amazed
thereat, nor believe that I have writ untruths,
but let him think that he hath erred in some-
thing, and especially they which have never
handled such things; For it is impossible that
they at the first time should be masters: there-
fore let them repeat the work, which they shall
always make better, and at the last perfect as I
describe it. I warn them in particular to have
consideration in colours whose certain and de-
terminate dose cannot be given: but with ex-
perience and practice one must learn, and with
eye and judgment know when Glass is sufficien-
tly coloured, conformable to the work, for which
it ought to serve, and in Paste made in imita-
tion of Jewels conformable to the size, where-
of they will make them, Observing that those
which are to be set in Gold, with Foyls, as in
Rings, or other where, must always be clear, and
To the Curious Reader.

of a lighter colour. But those that are set in
Gold to stand hanging in the air, as Pendants,
and the like, must be of a deeper colour, all
which things it is impossible to teach, but all is
left to the judgement of the Curious operator.
Observe likewise, and with diligence that the
materials and colours be well prepared, and
well ground, and that he who will make an ex-
quisite work, may be the securest, let him pre-
pare, & make all the colours himself as I teach,
for so he shall be sure that his work must hap-
pily succeed. The fire in this Art is of nota-
ble importance, as that which makes every thing
perfect, and without which nothing can be done:
wherefore consideration is to be had in making
it in proportion, and particularly with hard,
and dry-wood, taking heed of it's smoak, which
always hursteth, and endamageth it, especially
in furnaces, where the vessels and pots stand
open, and the Glass will then receive imper-
fection, and notable foulishness. Moreover, I say
that if the operator shall be diligent, and shall
do like a diligent and præst person, and shall
work punctually as I have set down, he shall find
truth in the present work, and that I have onely
published, and set out to the world as much as I
have tried and experimented. And if I find my
pains acceptable to the world, as I hope I shall
To the Curious Reader.

be incouraged perhaps to publish my other la-
bors wrought for many years in divers parts
of the world in the Chymical and Spagyrical
Arts, than which I think there is no greater
thing in nature for mans service, known and
perfect in ancient times; which made men ex-
pert in it to be held for Gods, which then were
held and reputed for such. I will not enlarge
my self any farther, because I have in the
work set down every particular, so clear, and
distinct. I rest secure, that he which will not
err wilfully, it is impossible he should do so
having thereof once made experience and pra-
actice. Therefore let all be taken of me in good
part, as I have candidly made this present work,
first, to the glory of God, and then to the just
benefit and profit of all.
To the Honourable,
And true Promoter
of all solid Learning,
ROBERT BOYLE, Esq;

SIR,

This Treatise challengeth the inscriptions of your name for many reasons. The Author of it Dedicated this piece to a Person of Honour, and eminent parts, both which concur in you, and herein I thought fit to follow his Foot-steps. Then your ability to judge of the piece, being for the most part Chymical, wherein you have shewed the world not only your great progress & singular knowledge, but have also taught it the true use of that most beneficial Art, as to the improvement of Reason and Philosophie. Most Writers therein delivering onely a farrago of processes and unintelligible Enigm'as. But you have chalked out the way of solid reasoning upon whatsoever occurs to observation in such experiments. Next, you were the principal cause that
that this Book is made publick, by proposing and urging my undertaking of it, till it came to a command from that most Noble Society, and serious indagators of Nature, meeting at Gresham College, whose desire I neither could nor ought to decline. Though their, and your choice might have been much more happy, there being many of that company far more adapted for this undertaking than my self. Besides, I doubt not but You will much promote by Your practice the Art it's self, there being scarcely any thing contained in it, but You have already judiciously had experience in. Not, because this Translation will any whit avail You (since Your skill in the native Language is sufficiently known to all that have the honour to be acquainted with You) but maybe compendious to You for such as You shall employ in these operations. Furthermore I have herein also satisfied Your vast desire of communicating knowledge to others, who though intelligent of the Language could not procure Copies in the Original; And lastly the candor of your genius no less than that of your intellectual readiness to excuse the errors, and slip whatsoever of.

Sir, Your most humble
and most regardful Servant,

C. M.
Courteous Reader,

I am to advertise thee of some things, concerning the Translation of this Book. You may take notice that I had first translated it word for word, but finding that the Author had throughout the whole, so often repeated the same thing, by advice of some ingenious persons, I left out those repetitions, and have either before the Books given a general account of these repetitions, or else have referred you to a former process, where the latter hath reiterated the same, and for the most part in the very same words, yet so that I have omitted nothing material in the Author: For what need is there to say, as often as Manganese is boil’d with the metall, that you must do thus and thus, lest it run into the fire, &c &c &c or to repeat the same process, and rules in each new colour for Pastels or Glass of
To the Ingenuous Reader.

of Lead? Though you may find some needless repetitions too, in this Translation not omitted. I confess these reiterations caus'd a nausea in my self, and believe they would in thee, and therefore I passed them over. Then observe that there being many words peculiar to this Art, I was compell'd to have recourse to the workmen, and for such things, and materials not used nor known here, to take them upon trust from such workmen as have wrought at Muran and other parts of Italy. As for other things I have carefully surved them my self. Now for the observations I have been more large, especially in a business, wherein so little hath been said, and therefore have delivered whatsoever is material that I have met with in any good Author concerning whatsoever Neri treats of, that thou might'st have together all that is substantially written upon this unusual subject, and have supplied some things defective in our Author, or very fit to be known to Curious persons. Lastly, I doubt not but our workmen in this Art will be much advantaged by this publication, who have within these twenty years last past much improved themselves (to their own great reputation, and the credit of our nation) insomuch that few foreiners of that profession are now left amongst us. And this
To the Ingenious Reader.

this I rather say, because an eminent workman, now a Master, told me the most of the skill he had was gain'd by this true and excellent Book (they were his own words,) And therefore I doubt not but 'twill give some light and advantage to our Country-men of that profession, which was my principal aim. And lastly for the exotic words you'll meet with in Reading this Book they are now current with us, or else expounded in my observations.

Frucere & utere.

C. M.
To avoid our Authors Repetitions, Observe

1. All the fires must be made with dry and hard Wood.

2. When the Glass is coloured before you work it, mix the colours well (which otherwise sink to the bottom of the pot) with the metall that the Glass may be coloured throughout. This must be observed all the time you work the Glass into any vessels.

3. The sign that Brass or Copper are well calcin'd is, that they being put into the metall, make it swell and suddenly rise, if they be calcin'd too much or too little, those signs are wanting, and Glass made thereof will be Black and foul.

4. Manganese consumes the natural greenness of Glass.

5. Copper, Brass, Lead, Iron, and all compositions of them as also Manganese, must be put into the metall, but a little at a time, and at convenient distances, and the pot must be large, and not filled too full, because they all swell and rise much, and so are apt to run over into the fire to your loss.
To extract the salt of Polvereine, Rochetta, and Barillia, wherewith Crystall Fritt called Bollito is made.

The foundation of the Art of Glass-work, with a new and secret way.

CHAP. I.

Olverine, or Rochetta, which comes from the Levant and Syria, is the ashes of a certain herb growing there in abundance: there is no doubt but that it makes a far whiter salt than Barillia of Spain, and therefore when you would
would make a Crystall very perfect and beautifull, make it of salt extracted from Polverine or Rochetta of the Levant. For though Barillia yield more salt, yet Crystall made therewith alwaies inclines to a blewness, and hath not that whiteness and fairness as that made of Polverine hath.

The way often by me practised to extract the salt perfectly from both of them, is this which follows.

Powder these ashes, and sift them with a fine sieve, that the small pieces go not thorow, but onely the ashes; the finer the sieve, the more salt is extracted. In buying of either of these ashes, observe that they abound in salt; this is known by touching them with the tongue, and tafting what salt they contain: but the sa-fest way of all is, to make an essay of them in a melting-pot, and to see whether they bear much sand, or Tarso, a thing common in this Art, and which the Conciators very well know.

Set up brass coppers with their furnaces like those of the Dyers, greater or lesser, according as you have occasion to make a greater or lesser quantity of salt.
fill these coppers with fair and clear water, and make a fire with dry wood, and when the water boyleth well, put in the sifted Polverine in just quantity and proportion to the water, continue the fire and boyling till a third part of the water be consumed, always mixing them at the bottom with a scummer, that the Polverine may be incorporated with the water, and all its salt extracted; then fill the coppers with new water, and boyl it till half be consumed, and then you have a lee impregnated with salt. But that you may have salt in greater quantity, and whiter, put into the coppers when they boyl, before the Polverine is put in, about 12 pound to a copper of Tartar of red wine, calcined only to a black colour, dissolve it well in the boyling water, mingling it with a scummer, then put in the Polverine. This way of Tartar is a secret, and makes more, and whiter salt, and a more beautiful Crystal. When two thirds of the water is evaporated, and the lee well impregnated with salt, slacken the fire under the copper, and have in order many earthen pans, at first filled with common water for six daies, that they may imbibe less lee and salt,
The first Book.

Salt, and then with great brass ladles, take the lee out of the copper, and put it into the said pans, take out also the ashes from the copper, and put them all into the same pans, and when they are full, let them stand so ten days, for in that time the ashes will be all at the bottom, and the lee remain very clear, then with brass ladles, take gently (that the bottom be not raised, and troubled) the clear lee, and put it into other empty pans, and so let the lee stand two days, which by the settling of more terrestrial at the bottom, becomes very clear, and limpid, let this be thrice repeated, and you shall have the lee most limpid, and discharged of all terrestrial, wherewith a very fine and perfect salt is made. Let the coppers be filled again, and boil with the same quantity of Tartar, and then the Polverine as before; continue this work till you have materials enough.

To strain the said lees, and extract the salt, first wash the coppers well with clear water, then fill them with the said refined and clarified lees, and make them boil softly, as before, and observe that you fill the coppers with the said lee, till you see it
it thicken, and shoot its salt, which is wont to be about the beginning of 24 hours, for then in the superficies of the copper, you will begin to see white salt appearing like a spiders web, or white threed, then hold a scummer full of holes at the bottom of the copper, and the salt will fall upon it, and now and then take it out, suffering the lees to run out well off it into the copper, then put the salt into tubs, or earthen pans, that the lee may be better drained, the liquor that drains must be saved, and put into the copper, then dry the salt. Continue this work till all the salt be gotten out of the copper: but you must observe, when the salt begins to shoot, to make a gentle and easy fire, for a great fire makes the salt stick to the copper, and then the salt becoming strong, alwaies breaks the copper, which thing hath sometimes hapned to me; wherefore observe this chiefly, using great patience and diligence. The salt in the pans, or tubs, being well drained, must be taken, and put into wooden tubs, or vats, the better to dry out all the moisture, which happens in more, or fewer daies, according to the season in which it is made.
made. The secret then of making much, and good salt, consists in the Tartar, as is before demonstrated. From every three hundred pound of ashes, I usually get from 80 to 90 pound of salt. When the salt is well dryed, beat it grossly, and put it into the Calcar to dry, with a most gentle heat, and with an iron rake it must be broken, and mixed as the Fritt is; when it is well dryed from all its moisture, observing alwaies that the Calcar be not very hot, but temperate, take it out of the Calcar, and pound it well, and sift it so, that the greatest pieces which pass thorrow, exceed not the bignets of a grain of wheat.

This salt thus pounded, sifted and dryed, must be kept by itself, in a place free from dust, for to make Fritt of Crystal: the way to make this Fritt is this which follows.
The way to make Fritt for Crystal, otherwise called Bollito.

CHAP. II.

When you would make fair, and fully perfect Crystal, see you have the whitest Tarso, which hath not black veins, nor yellowish like rust in it. At Moran they use the pebles from Tesino, a stone abounding in that River. Tarso then is a kind of hard, and most white marble, found in Tuscany, at the foot of the Verucola of Pisa, at Seraveza, and at the Massa of Carara, and in the River Arnus, above and below Florence, and it is also well known in other places. Note, that those stones which strike fire with a steel, are fit to vitrifie, and to make glass and Crystal, and those which strike not fire with a steel, will never vitrifie, which serves for advice to know the stones that may be transmuted, from those that will not be transmuted into glass.

Take then of the best Tarso, pounded B 4 small,
small, and serced as fine as flower, 200 pound; of salt of Polverine pounded, and sifted also, about 130 pound, mix them well together, then put them into the Calcar, which at first must be well heated, for if they be put into the Calcar when it is cold, Fritt will never be made of them. At first for an hour, make a temperate fire, and alwaies mix the Fritt with the rake, that it may be well incorporated, and calcined, then the fire must be increased, alwaies mixing well the Fritt with the rake, for this is a thing of great importance, and you must alwaies do thus for 5 hours, still continuing a strong fire.

The Calcar is a kind of calcining furnace, the rake is a very long instrument of iron, wherewith the Fritt is continually stirred; both these are very well known, and used in all glass furnaces. At the end of 5 hours, take the Fritt out of the Calcar, which in that time (having had sufficient fire, and being well stirred) is made and perfected. Then put this Fritt in a dry place on a floor, and cover it well with a cloath, that no dust nor filth may fall upon it: for herein must be used great diligence, if you will have good Crystall. The Fritt thus
thus made, becomes as white as snow from Heaven. When the Tarso is lean, you must add somewhat more than ten pound of the salt to the quantity aforesaid. Wherefore let the experienced Conciators alwaies make tryal of the first Fritt, by putting it into a chrysible, which being put into the furnace, if it grow clear, and suddenly, they know whether the Fritt be well prepared, and whether it be soft, or hard, and whether the quantity of salt is to be increased, or diminished. This Crystall Fritt must be kept in a dry place, where no moisture is, for from moist places, the Fritt suffers much, the salt will grow moist, and run to water, and the Tarso will remain alone, which of itself will never vitrifie: neither is this Fritt to be wetted, as others are. And when it is made, let it stand 3 or 4 months, and it will be much better to put into the pots, and sooner waxes clear. This is the way to make Crystall Fritt, with the dose and circumstances, which I have oft times used.
Another way to extract the salt of Polverine, which makes a Crystal as fair and clear as natural Crystal: This was my invention.

CHAP. III.

Take Polverine of the Levant well forced, and put it into great glass bodies, luted at the bottom, with ashes, or sand, into the furnaces, filling them at first with common water, give them a temperate fire for some hours in the furnace, and let them stand till half the water be evaporated; the furnace being cold, gently decant off the water into earthen pans glazed, putting new water upon the remainder of the Polverine, and let it boil (as before) this is to be repeated till the water hath extracted all the salt; which is known, when the water appears to the taste not at all saltish, and to the eye when it is void of colour. Take of these Lees what quantity you will, let them be filtered, and stand in
The first Book.

in glazed pans four or six days to settle, which by this means will leave a great part of their terrestriety, then put them to filtre anew, thus will they be purified, and separated from a great part of their terrestriety, then let these Lees be set to evaporate in great glass bodies, luted at the bottom, in furnaces, in ashes, or sand, at a gentle fire, and at last when the stuff is dryed, observe that ye fire be very gentle, that the salt be not burned nor wasted. When the salt is dried, take out the glass bodies and see if they be broke at the bottom, which is wont to happen often, in which case put the said salt into other good glasses, well luted at the bottom, and fill them at the top with common pure and clean water, which set in the furnace, in ashes or sand, at a gentle fire, and always evaporate an eighth part of the said water, then, the furnace being cold, empty this water fully impregnated with salt into earthen pans glazed, and when the water is settled 24 hours, filtre it with diligence, that the salt may be separated from the rest of the terrestriety and dregs, let this lee be evaporated in glass bodies with a gentle fire, and at last more gentle, that the salt be
be not burned, put this salt again into glass bodies to be dissolved in common water, in every thing as before repeat this work, till the salt yields no more terrestriety, or dregs, then shall you have a pure and perfect salt wherewith a Fritt made with Tarso as before, will make a Crystall, which in fairness, whiteness, and cleerness, will excel natural Crystall.

An observation for Gold Yellow, in Crystall.

CHAP. IV.

Observe that when salt of Tartar is mixed with salt of Polverine, a Fritt made of the said salt is not good to make, nor can make, a Gold yellow, although it make all other colours. But to make your Gold yellow, you must make Fritt with salt taken from Polverine alone, first purified as above, for otherwise this yellow will not arise. Although this process be somewhat laborious, and a small quantity of salt made therewith, yet not-
The first Books.

withstanding it will make a Crystall worthy of all great Princes, being fit to make all sorts of vessels and works. This was my invention, whereof I have many times made trial with happy success and my great content.

The way to make salt of Fern, which makes a very fair Crystall.

CHAP. V.

IN Pisa I made experience of Fern ashes which groweth in great abundance in Tuscany, which herb must be cut from the earth, when it is green, from the end of May to the midst of June, and in the Moons increasing, when it is near it's opposition with the Sun; for then the laid herb is in it's perfection, and will then make more salt, and of a better nature, strength and whiteness, than at other times: for when it is suffered to dry of it's self upon the ground it yields little salt, and of little goodness. This herb being thus cut and laid together, soon wi-
The first Book.

there, then let it be well burned to ashes, with these ashes, and with the rules, observations, and diligence given before for the salt of the Polverine of the Levant, is extracted a pure and good salt, wherewith I have made Fritt with good and well served Tarso, the which Fritt melts well in the pot, and yieldeth a fair Crystall, and much better than the ordinary Crystall, because it had more strength and bended much better, which the ordinary Crystall doth not, it is drawn into fine threads, such as I caused to be drawn, and to this Fritt may be given a wonderful yellow Gold colour, observing that there be in it no salt of Tartar, for neither from this will the Gold yellow arise, and the Gold yellow which is given to this Crystall is much fairer and pleasanter than can be wrought with the Crystall made with the salt of the Levant Polverine, and with that Crystall cannot be made all sort of works as with the other.
The way to make another Salt which will produce a marvelous and wonderfull Crystall.

CHAP. VI.

Let there be made ashes after the manner aforesaid, of the Cods and Stalks of Beans, dried in the summer, when ye husbandmen have thrashed and separated the Beans, with which ashes, with the rules and pains aforesaid in the salt of Polverine, a marvellous salt is extracted, wherewith is made a very noble Fritt with white and well serced Tarso, which in pots will make most beautiful Crystall; the same may be done with the ashes of Coleworts, Bramble Berry bush, and also with stalks of Millet, Rushes, and fen Reeds, and many other herbs which yield a salt, wherewith (making Frits after ye accustomed manner) will be made most beautiful Crystall, as every noble and curious spirit may try by experience, for thereby more is learned than by long study.
A salt that will make a very fair Crystall.

CHAP. VII.

Take the salt of Lime which serves for building, and this salt purified and mixed with the ordinary salt of Polverine of the Levant about two pound to a 100. that is two pound of salt of Lime to a 100 pound of the salt of Polverine purified and well made (as abovesaid) with this salt so mixed is usually made ordinary Fritt; and is put in the pot to clarifie, as shall be hereafter declared in the way of making of Crystalline, Crystall, and common glass, and so thus made a very fair and beautiful Crystall.
The way to make ordinary Fritt, to wit of Polverine, Rochetta, and Barillia of Spain.

CHAP. VIII.

Fritt is nothing else but a calcination of those materials which make glass, and although they may be melted, and make glass without calcination, yet this would succeed with length of time and weariness, and therefore this calcination was invented to calcine the Fritt in the Calcar, which, when it is calcined, and the proportion of the materials is adjusted agreeable to the goodness of the Barillia, presently melts in the pot, and wonderfully clarifies.

Fritt made of Polverine makes ordinary white glass; Fritt from Rochetta of the Levant makes the fairest glass called Crystal; Barillia of Spain, though it be usually fatter than the former, yet it makes not a glass so white and fair as that of the Levant, because it always inclines a little to an azure colour.
To make then Fritt, force the Polverine thorow a fine ferce, the small pieces which pass not, let them be pounded in stone mortars, the like is to be done with the Rochetta and Barillia, to wit every one by it's self, and be sure that they be well pounded, and serced thorow a fine ferce; for as the common proverb in this art faith, A fine ferce, and dry wood, bring honour to the furnace. Now whatsoever the quantity of the Barillia be, for example, a 100 pound of it commonly requires, from 80 pound to 90 of Tarso, which must be finely beaten, and then finely serced, more or less, according to the goodness of the Barillia, and it's fatness, whereof you need not make an essay, how much it holds as is known by art. Then with sand, and especially with that from Tuscanie found in the vale of Arno, being much fatter, and having in it more plenty of salt, than Tarso hath. There is never added more than 6 or 8 pound to the hundred. Now this sand must be washed from all it's unprofitable terrestriety, and serced, and then this will make a white and good glass; for Tarso always makes much fairer glass than any sand that is in Tuscany. The due quantity
tity of sand or Tarso, being found out, mix and unite them, first well together with the Barillia or Polverine well sifted, and so put them into the Calcar when it is hot, & at first mix & spread them well in the Calcar, with a rake, that they may be well calcined, and continue this till they begin to grow into lumps, and come into pieces as big as small nuts. The Fritt will be well and perfectly wrought in the space of 5 hours, being stirred all that time, and a sufficient fire continued, and when you would see whether it be well made, take a little of it out, when cold, if it be white, yellowish and light, then 'tis made. The calcining of it more than 5 hours is not amiss; for by how much more it is wrought and calcined, the better it is, and the sooner it melteth in the pot, and by standing a little longer in the Calcar it consumeth and loseth the yellowness and foulness which glass hath in itself, and it becomes more clear and purified. When the Fritt is taken out of the Calcar thus hot, let there be thrown upon it 3 or 4 pails of cold water, then set it under ground, in a moist and cold place, and the filth which arose when the salt was made (as is a-

C 2

bove
The first Book.

bove said) is wont to be put into the same pans, with the lee from Polverine; fill them with common water, having tubs under the pans to receive the water, which by little and little drops through the said filth and setlings, and hence comes a very strong pure and clear lee to be kept apart, and herewith now and then water the Fritt abovesaid, which being heaped together in a moist place the space of 2 or 3 moneths or more (the longer the better) then the said Fritt grows together in a mass as a stone, and is to be broken with mattocks. Now when it is in the pot it soon melteth stupendiously, and maketh glass as white as Crystall. For this Lee leaves upon the Fritt it's salt which worketh this effect. When this Lee is not to be had it must be watered with common water, which although it doth not work this great effect as the laid lee, yet it doth well, and maketh it easier for melting. Wherefore Fritt should stand, when made, some moneths, which thus made alway causeth less wood to be consumed, and the glass clear and sweeter to work.
To make Crystall in full perfection, the way I always practice.

CHAP. IX.

Take Crystall Fritt diligently made, set it in pots in the furnace, where there are no pots with colours, for the fumes of metals whereby the greatest part of colours are made, make the Crystall pale and foul, but that it may come forth white, shining, and fair, when you put the Fritt into the pots in the furnace, then cast in such a quantity of Manganese prepared as is needful, according as the pots are, greater or less. For this lieth in the practice of the able and diligent Conciatore, and belongs to his office. The quantity of the Manganese and of all other colours to be put into the Fritt and metals cannot be precisely determined either by weight or measure, but must be wholly left to the eye and judgement, trial and experience of the Conciatore. To make a fair Crystal, when it is well melted take it from the pots, and cast
The first Book.

it into great earthen pans, or clean bowls ful of clean water (for it requireth to be cast into water) to this end that the water may take from it a sort of salt called Sandever, which hurteth the Crystall, and maketh it obscure and cloudy, and whilst it is a working still casteth forth Sandever, a thing very foul. Then put it again into a clean pot, and cast it into water, which is to be repeated as often as is needful, until the Crystal be separated from all this salt, but this is to be left to the practice of the Conciator, then set it to boil 4 or 6 days, and let as little Iron be mixed therewith as is possible, for it gives it always a blackish tincture. When it is boiled and clear, see whether it hath enough Manganese, and if it be greenish, give it Manganese with discretion. Wherefore to make good Crystall put in the Manganese by little and little at a time, for it makes the Crystall of a murry colour, which afterward inclines to black, taking from it it's splendor; mix the Manganese, and let the glass clarifie till it becomes of a clear and shining colour. The property of Manganese is, being put in just quantity to take away the foul greasines which Crystall always hath, and to make a resplen-
resplendent white, when the Crystall is clear limpid & fair, work it continually into vessels and works that most please you, but not with so great a fire as common glass is wrought with. Be careful that the Irons wherewith you work be clean, and that you put not the necks of the glasses where the Irons touch (for there always remaineth Iron) into the pots of Crystall, for they make it become black. But this glass where the Iron rods touch may be put in to make glass for vulgar works.

To make Crystall-glass, and white, call’d otherwise common glass.

CHAP. X.

Fritt of Polverine makes a white and fair common glaı̂s, Fritt of Rochetta makes the fairest glaı̂s called Crystall, which is between ordinary glaı̂s and Crystall. As much Manganese prepared must be used in common glaı̂s as is in Crystalline; cast the Crystalline or common glaı̂s once at least into water, that you may have them fair,
The first Book.

fair, clear, and in perfection. Although glafs may be made without this casting into water, yet to have it fairer than ordinary, this is necessary to be done, and may be repeated according to your pleasure, as you would have them more resplendent and fairer, and then you may work them into what vessels you need. And to make them yet whiter, Calcine them that they purifie well and have but few blisters. And above all observe, that if to each of them, by themselves, you put upon the Fritt, the proportion of 12 pound of salt of Tartar purified to a 100 weight of Fritt, it makes them without comparison fairer, and more pliable to work than ordinary. The salt of Tartar must be put in when the Fritt is made, and then be mixed with Tarso, or sand, together with the Polverine or Rochetta sifted, and then make thereof Fritt as before.
To make Purified salt of Tartar, for the work abovesaid.

CHAP. XI.

Take Tartar of red wine in great lumps, and not in powder. Calcine it in earthen pots between live coles till it become black, and all it's unctuosity be burned away, and till it begins to grow white, but let it not become white, for then the salt will not be good. Put the said Tartar thus Calcined into great earthen pans full of common water heated, as also into earthen pots glazed, & make it boil with a gentle soft fire in such sort that a quarter of the water may be exhaled in two hours, then take them from the fire, and suffer the water to cool, and become clear, which decant off, and it will be a strong lee, then put in more common water into the said pans after the same manner, and upon the remainder of the Tartar, and let them boil as before, repeat this until the water become no more sal-
tish, then Filtre these waters impregnated with salt, and put the clean Filtred lee into glass bodies to evaporate in the ashes of the furnace at a gentle heat, and in the bottom there will remain a white salt, dissolve this salt in warm water, let it settle two days, then evaporate it in glass bodies at a gentle heat, and there will remain at the bottom a salt much whiter than at the first time, dissolve this salt again, and after two days settling, Filtre and evaporate it in every thing as before. Repeat this manner of dissolving, Filtling, evaporating this salt of Tartar four times, which then will be a salt much whiter than snow, and purified from the greatest part of it's Terrestriety, which salt mixed with Polverine or Rochetta tereed with a dose of Tarso or sand will make a Fritt, which in the pot will yield Crystalline and common glass much fairer than that that is made without the addition of this salt of Tartar, and although a fair Crystalline may be made without it, yet notwithstanding a much fairer may be made with it.
To prepare Zaffer which serves for many colours.

CHAP. XII.

Take Zaffer in gross pieces, put it into earthen pans, let it stand half a day in the furnace, & then put it into an Iron ladle to be heated red hot in the furnace, take it thence thus hot and sprinkle it with strong vineger, as soon as 'tis cold grind it fine on a Porphyrie stone, wash it in earthen pans glazed, with much warm water, always suffering the Zaffer to settle to the bottom, then decant it gently off; this will carry away the foulness and Terrestriety from the Zaffer, and what is good, and the tincture thereof will remain at the bottom, which thus prepared and purified will tinge much better than at first, making a limpid and clear tincture, which dry and keep in vessels closed for use.
To prepare Manganese to colour glass.

CHAP. XIII.

Take Manganese of Piemont, for this is the best of all the Manganesees at this day known in the art of glas. At Venice there's not always plenty, and at Moran none other is used. In Tuscanie and Liguria there's enough; but that holds much Iron, and makes a black foul colour. That of Piemont makes a very fair murry, and at last leaves the glass white, and takes away the greenness and blewness from it. Put this Manganese in pieces into Iron ladles, and proceed thorowout as in preparing Zaffer.
To make Ferretto of Spain which serves to colour glass.

CHAP. XIV.

To make Ferretto is nothing but a simple Calcination of Copper, that the metall being opened, may communicate its tincture to glass, which Calcination when it is well made without doubt makes divers and very beautiful colours. This Calcination is made many ways, I shall set down two of them, not only easy but of times used by me, with effects very fair, in glass, whereof the first is this that followeth, to wit, Take thin Copper-plates of the bigness of a Florentine, and have one or more melting pots of the Goldsmiths, and in the bottom of these pots make a layer of brimstone powdered, then a layer of the said plates, and over them another layer of powdered brimstone, and another of Copper-plates, as before, and in this order fill the pot, which is otherwise said to make a S S S. cover and lute well, and dry
dry this pot, and put it into an open wind furnace amidst burning coals, and a strong fire must be given to it for 2 hours, let it cool, and you shall find the copper calcined, and it will be broke in pieces by the fingers as if it were dry earth, and will be raised into a black and reddish colour. This Copper being beaten small and forced in a fine fierce is kept well closed for use.

Another way to make Ferretto of Spain.

CHAP. XV.

This second way of making burnt Copper, though it be more laborious than the first, yet it will do it’s effects in glass more than ordinary.

The Copper then (instead of making a SSS with Brimstone) must make a SSS with Vitriol, and then Calcine it, letting it stand three days in the floor of the furnace, near the occhio, then take it out & make another SSS with new Vitriol, keep it in reverberation as before, & this Calcination with Cop peras
The first Books. 31

peras must be repeated six times, and then you shall have a most noble burnt Copper, which in colours will work more than ordinary effects.

To make Crocus Ferri, otherwise called Crocus Martis, to colour glass.

CHAP. XVI.

Crocus Martis is nothing else but a subtilizing and Calcination of Iron, by means whereof it's tincture (which is most red in glass) is so opened that it communicateth it's self to glass, & not only manifesteth it self, but makes all other metalline colours (which ordinarily are hidden and dead in glass) appear fair and resplendent; I will set down four ways to make it, and the first is.

Take filings of Iron (if you can have them, those of steel are better) mix them well with three parts of powdered brimstone, and keep them in a melting pot in a furnace to Calcine, and burn well off all the
the brimstone, which soon succeeds, let them stand four hours in burning coals, then take and powder, and seare them thorow a fine seare, and put them into a Chrysible covered and luted at the top, & set them in the Leer of the furnace neer the occhio or the cavalet 15 days or more which then gains a reddiss Peacock-like colour, as if it were purple, this is kept in a close vessel, for the use of glass colours, for it worketh many fair feats.

The second way to make Crocus Martis.

CHAP. XVII.

This second way of making Crocus Martis, with so much ease, ought to be much esteemed of, since the Crocus made in this manner makes appear in glass the true red colour of blood, and the manner of making it is thus,

Take filings of iron (steel is better) mix them well in earthen pans with strong vineger, onely sprinkling them so much that
that they may be wet thoroughout, spread them in pans, and set them in the sun till they be dry, or in the open air when the sun is cloudy. When dry, powder them, and if they be any whit in lumps, sprinkle them with new vinegar, then dry and powder them as before, repeat this work 8 times, then grind and serve them fine, and you have a most fine powder of the colour of brick powdered, which keep in vessels to colour glass.

A third way to make Crocus Martis.

CHAP. XVIII.

This third way of making Crocus Martis, is a way by which the deep colour of Iron is made more manifest than may seem credible; and in glass is seen the truth and proof thereof. Sprinkle filings of steel with Aqua-fortis, in glased pans, set them in the sun to dry, powder them, wet them again with Aqua-fortis and dry them, repeat this several times, and you shall have
The first Book.

have a red powder, as is said of Crocus made with Brimstone, then powder, seeing, & keep it for your use to colour glass.

CHAP. XIX.

A fourth way to make Crocus Martis.

This is the fourth and last way to make Crocus Martis, and perhaps the best of all, though each of the ways shown by me, are not only good and perfect in their operation, but necessary also for divers colours necessarily & daily made in glass, & to make this, dissolve in Aqua-fortis made Aqua-Regis, with Sal Armoniack (as shall be said in our rules of Calcidony) filings of Iron or Steel in a glass vessel well closed, keep them so 3 days, & every day stir them well. Observe, when the said water is put upon the filings, that it be done leisurely, & warily, because it riseth much, and endangereth the breaking of the glass, or else all to run out: at the end of 3 days let the water be gently evaporated away, and in the bottom
The first Book.

To Calcine Brass called Orpello or Tremolante, which in glass makes a skie colour, and sea green.

B rass (as it is well known) is Copper, which by Lapis Calaminaris becomes of the colour of gold, the which Lapis Calaminaris, doth not only colour the Copper, but also incorporating with it increaseth much it's weight; the which augmentation gives a colour to glass, when it is well Calcined, which is a thing very delightful to see, keeping the medium between a Sea-green and a skie-colour, when the Skie is clear and serene, wherefore be diligent in well Calcining it; to make it punctually, this is the way.

Take Brass, and to save charges, buy that which is in works, and Festoons, cut it in small pieces with a pair of Scisers, then put
put it into a Chrysible covered and luted at the top in coals on a strong fire. I put it in the burning coals of the furnace where they are stirred, there let it then stand four days in a great, but not in a melting fire, for if it be melted, all the labour is lost, in that time it will be well Calcined, powder it into a most subtil powder, and searse it, and grind it fine upon a porphyrie stone, and there will come forth a black powder, which spread on tiles, and keep it on the burning coals in the leer, near to the round hole, four days, take from it the ashes that fall upon it, powder, searse, and keep it for use. The sign that it is well Calcined is, that if it be put into glass it makes it swell, and when it makes not the glass arise and boil well, it is a sign, either that it is not well Calcined, or that it is too much burnt, in which two cases, it makes not the glass boil, neither doth it colour well.
To Calcine the said Brass, after another manner, to make a transparent red, a yellow, and Calcidon.

CHAP. XXI.

Take Brass and cut it small with sheers, and put it in a melting pot, make a S S S. with powdered Brimstone, and set it on kindled coals, put it in the burning coals of the furnace to Calcine for 24 hours, then powder, sheer, and put it covered upon tiles of earth into the furnace, for 12 days, to reverberate, then grind, powder, and keep it for use.
Sea-green is one of the principal colours given to glass, and if you would have it fair, and to hold at all trials, you must always make it in glass called Artificial Crystal; for in ordinary metall it ariseth not fair: and though in Crystalline it ariseth fairer than in common glass, yet in the said Crystal, only in perfection. Observe, that when ever you would make this colour, you in no wise add any Manganese at first, because this being added (although the fire afterwards consumes it,) yet it leaves a quality in the glass, which makes the colour black, and gives it great imperfection and foulness. Now to make a fair Sea-green, take of Crystal Fritt, and put it in a pot, not allowing it any Manganese at all, and as soon as it is melted and clear, it yields a salt which swims at the top like oyl, let this be taken off with Iron ladles,
by the Conciators, take it out with much diligence, for what remains thereof, will make a foul, and oyl colour, and when the glass is well and perfectly clarified, take a pot of about twenty pound of Crystal, six ounces of Brass prepared as is aforesaid, and to this Brass calcin'd, add a fourth part of Zaffer prepared, and let these two powders be well mixed, and put to the said Crystal at three times, but at first this powder will make the metall swell very much, and you must well mix the glass with the long squares. Then let the metall settle, that the colour may be incorporated for three hours, then mix them again with the long square, then take a proof thereof, in doing whereof, put in rather too little than too much, for the colours may be easily heightned, which is to be done according to the works for which it is to be employed, for gross tubes for counting houses require not so deep and full a colour, and tubes to make beads of, must not have too light a colour. At the beginning of twenty four hours (after it hath had the due colour) it may be wrought, and before you work it, mix well the metall from the very bottom of the pot, that the colour may be
be well united, mixed, and spread through all the metall, otherwise it settles to the bottom, and the metall at the top becomes clear. This manner of making Seagreen, I have tried at Florence in the year 1602 and made pots for tubes for counting houses, always of a most fair colour. At Moran for the said tubes, they take half Crystall Fritt, and half Rochetta Fritt, from whence notwithstanding proceeds a fair Sea-green, although in Crystall alone it ariseth most fair.

Skie Colour or Sea-green.

CHAP. XXIII.

Set in the furnace a pot of pure metall of Fritt from Rochetta, or Barillia of Spain. The Rochetta of the Levant does best. As soon as the metall is well purified, then take to a pot of 20 pound six ounces of Brass calcin'd of it's self, as in 20 Chap, put it into the metall as is said in the Skie-colour in every particular; observing that this metall be skummed very diligently with
with a ladle. At the end of two hours the metall must be very well remixed; take thereof a proof, and leave it so 24 hours, then it is mixed, and wrought, and this will be a most fair and marvellous Skie-colour varied with other colours, which are made in the art of glass. This colour tinged many pots in Pisa in the year 1602 and there came out a fair colour bearing all proofs.

---

A Red colour from Brass for many colours.

CHAP. XXIV.

Take Brass in small plates, and put them on the arches of the furnace, leave them there closed until they are well Calcined of themselves with a simple fire, but not to melt. As soon as it is Calcin’d & powder’d it will become a red powder, for many, and those all necessary uses in the art of glass.
Brass thrice Calcined to colour glass.

CHAP. XXV.

Put the said Brass into the Fornello, or on the Lere of the furnace neer to the occhio, into earthen tiles or pans baked, Calcine it four days together, and it will become a black powder, and stick together, powder it again, serce it fine, and Recalcine it as before four or five days, for then it will not stick together, nor become so black, but russet, and powders of it self, wherewith is made a Sea-green, and Emeral’d-green, the Arabian colour called Turcois, a very beautiful Skie colour, with many others. Wherefore observe that it be not too much nor too little Calcined at the third Calcination, for in this case it colours not the glass well, & the sign, that it is done perfectly is, that being put upon purifi�d metal it makes it swell & boil suddenly, and when it doth not so it is not good nor well Calcin’d.
The first Book.

A Sea-green in Artificial Crystal.

CHAP. XXVI.

To a pot of Crystal Fritt containing 40 pound not charged with any Manganese, but well scummed, For when you would make a Sea-green, never cast the Crystal into water, but onely scum it carefully, when this Fritt is melted and well purified, take 12 ounces of thrice Calcin'd brass, and therewith mix half an ounce of Zaffer prepared, unite these two powders well together, and put this mixture into the pot at four times, for so the glass receiveth it better. Mix the glass and powder with diligence, let them stand two hours, then remix them & take a proof, & if the colour be full enough, let them stand; And although the Sea-green appears too full, yet the salt which is in the glass will eat up and consume the said greeness, and will always incline it to a bleuishness. And at the beginning of 24 hours it may be wrought. I have many times experimented this way
way of making Sea-green without ever erring. And if a moiety of Rochetta first be mixed with Crystal Frit, there will arise a fair Sea-green, and in Crystal alone 'tis marvellous fair.

General observations for all colours.

CHAP. XXVII.

That the colours may arise in full beauty and perfection, observe that every pot great or small, that is new, and put the first time into the furnace, leaves a foulness in glass from its terrestriety, so that all the colours that are made in them appear bad and foul; wherefore those pots that are very great may be glazed with white melted glass, as the Conciators well know, but the second time the pots lose this foulness. Observe secondly, that those pots which serve for one colour must not be used for another, for example, a pot which hath been used for yellow, is not good to make a grain colour, and that which makes a grain
grain-colour is not good to make a green-colour, and that which serves for a red is nor good to make a blew, and so of all other colours. Therefore every colour must have it's own pot, for in this manner the colours will become more perfect. Thirdly, that the powders be well calcin’d (that is) neither too much, nor too little; for in either of these cases they do not colour well. Fourthly, that a due proportion, and dose be used, and the mixture be made in proportion, and the furnaces be hot, and fed with dry and hard wood. Fiftly, that the colour must be used dividedly, to wit, one part in the Fritt, and the other in the metall, when it is melted and purified. There are other observations also which shall be treated of in their places, when we treat particularly of colours.
The first Book.

To make Copper thrice Calcin'd with more ease and less charge than the former.

CHAP. XXVIII.

Take the Scales which the Brasiers make when they hammer pans, kettles, or other works of brass, which being often put into the fire the workmen hammer them, and these scales fall off, which cost much less than solid brass, wherewith is made the stuff hereafter described. And to Calcine it, you need not open and shut again the arches of the furnace (as in the aforementioned way) a thing of much disadvantage and disturbance to the furnace. Take then those scales that are clean, and free from all earth and foulness, wash them with warm water, many times from their filth and uncleanness, and then let them be put into pots and pans of baked earth, and be kept in the leer near the Occhio, or in furnaces made for this purpose. I made at Pisa a little furnace in the fashion of a little Calcat.
Calcar, where were calcin'd 20 or 25 pound of these scales in few hours. Now let them stand in the said place four days, then renew them, powder and force them fine, then again put them in the pans and pots of earth as before, with the same fire and heat as aforesaid for four days more, and they will come into a black powder, and run into lumps, beat, and force those lumps fine, and repeat this process again, and a third time, then the scales will be prepared with much less charge than the former, and will thorowly have the same effect as the former; these scales rise much, wherefore use the prescribed care.

A fair Sea-green in Crystal metall, with the above-said scales.

CHAP. XXIX.

Take a pot of sixty pound of Crystal Fritt well scummed, and not cast into water. I made a Sea-green without wetting the Crystall metall, and thought that it came out better. But we may make tryal of
of both ways, and stick to the best. Then take of metall well purified the said 60 pound, and one pound and a half of the said seals made with less charges, four ounces of Zaffer prepared, mix well these two powders together, put them to the Crystall at four times, mixing well the powder with the metall for two hours, than put it again to be well remixed as 'tis usual, and take a proof. Herewith I have made many times a most fair Sea-green with happy success. Mix half Crystall with Rochetta, and you shall have a Sea-green every way beautiful.

A Sea-green of lesser charge.

CHAP. XXX.

Take the same Brass prepared (as before) with the same quantity of Zaffer, put them in the same manner and form to the Rochetta of the Levant, and also to that of Spain, neither of which hath had any Manganese, and which hath been well skummed, and not passed thorow water, using
singing the rules as aboveaid in Crystal; for by this means it will receive a very fair Blew for all sorts of works, and will cost much less than Crystal: for the Rochetta is of much less value than the Crystal, as it is known. In this manner have I often made it at Pisa, and always with good success.

---

A marvellous Sea-green, above all Sea-greens, of my invention.

C H A P. XXXI.

Let the Caput mortuum of the spirit of Vitriol of Venus Chymically made without corrosives stand in the air some few days; draw from it of itself without any artifice a green pale colour, this material being pulverised with the addition of Zaffer prepared, and with the same porportion (as is said in the other prepared Brasses) the metallic being added (as in the other Sea-green) it will make a Sea-green, so fair and marvellous, that 'twill seem a very strange thing: I have often made it at Antwerp.
The first Book.

Antwerp to the wonder of all the spectators that saw it. The manner of making Vitriol of Venus, without corrosives, Spagyrically, is to take little thin pieces of Brass of the bigness of half a Florentine, and to have one or more pots (as it is needful) and in the bottom of them to put a layer of common Brimstone powdr'd, and above it little pieces of the brass aforesaid, and than a layer of Brimstone, and after that pieces of Brass, work in this manner till all the Brass that you have be set to work, this being done, let the Brass be baked as followeth in the 140 Chap. then prove it, and to your content you may see a thing of astonishment. I know not whether any have tried this way, which I have found wonderful, wherefore I say 'tis my own invention.
A green Emerald colour in glass.

CHAP. XXXII.

In making Green you must observe that the metall have not much salt, with metall that hath much salt as Crystall and Rothetta have, you cannot make a fair Green, but only a Sea-green, for the salt consumes the Green, and always inclines the colour to a Blew. Wherefore when you would make a fair Green put common metall made with Polverine, into small or great pots, and in no wise have any Manganese. When it is melted and well purified, add to this metall a little Crocus Martis calcin'd with vineger, about three ounces thereof to a hundred weight, let the metall be well mixed, and remain so an hour until the glass incorporate the same tincture of the metall Crocus, which will make the glass come out Yellowish, and takes away the foulness and Blewness, which the metall always hath. This process will give the metall a fair Green. Put of thrice calcin'd
The first Book.
cin'd Brass, made with scales ( as before )
two pound to every hundred pound of
metall, and this must be added at six times,
mixing well the powder, with the metall,
then let them settle two hours, and the
metall incorporate with it, then mix again
the metall, and take a proof, and if the
Green enclines to a Blew, add a little more
Crocus Martis, so you shall have a very fair
Sea-green, called Leek green, which at the
end of twenty four hours may be
wrought: This Green I have many times
made at Pisa, which came forth sufficiently
fair. And to it will to every one that shall
observe punctually what is abovesaid.

A Green fairer than the former.

CHAP. XXXIII.

But if you would have a Green much
fairer and shining than the former,
put into a pot of Crystalline which hath
not had any Manganese, and which hath
passed thorow water once or twice, till
all the saltines be gotten out, and to this
Cry-
Crystalline; let half of common white metall made of *Polverine* be put in at several times, as soon as this metall is well mixed and purified, take to every hundred pound, two pound and a half of thrice Calcin’d brass, made with plates of Brass in the arches of the furnace, and with this mix two ounces of *Crocus Martis* Calcin’d with Brimstone, and reverberated, put these two powders well mixed together to the abovesaid metall, using the rules as before in the said Green, if the metall hath any Blewness give it a little of the said *Crocus Martis*, which takes it away, and then work it as the other Greens, and there shall be made the wonderfull Green of the *Burnet*. I have thus made it many times at *Pisa* with very good success, for works more exact than ordinary. If you will have a fair colour, see that the Brass be well prepared.
The first Book.

A marvellous Green.

CHAP. XXXIV.

TAke Brass thrice calcin’d as before, then in stead of Crocus Martis, take the scales of iron which fall from the Smiths anvils, powder them finely, sift them clean from the coals and ashes, and with the quantity aforesaid, mix them well with the Brass, and put them to the common glass metall of Polverine, without any Manganese, with the rules aforesaid in the Green, and with this Crocus Martis, or scales, you shall doubtless have a more marvellous Emerald Green-colour, which will have wholly lost it’s Azure and Sea-colour, and will be a Yellowish green, after the Emerald, and will have a shining and fairer lustre than the aforesaid Greens. The putting in of scales of iron was my own invention. In the rest of the work let the rules and doses as in other Greens be observed, and you shall have a strange thing, as experience hath often shown me. Another
Another Green, which carries the Palm from all other Greens, made by me.

CHAP. XXXV.

To a pot of 10 pound of metall to wit half of Crystalline passed thorow water several times, and half of common white metall of Polverine, take four pound of the common Frit of Polverine, where-with mix three pound of red Lead, unite them well together, and put them into the same pot, and in few hours all of them will be well purified, then cast all this metall into water, and take out the Lead, then return the metal which hath passed thorow the water into the pot, & let the metall purifie for a day, then if you put in the colour made Chymically with the powder of the Caput mortuum of the Spirit of Vitriollum veneris, adding a very little Crocus Martis, there will arise a marvellous Green, fairer than ever I made any, which will seem to be a very Emerald of the ancient Oriental rock.
A Blew or Turcois, a principal colour in this art.

CHAP. XXXVI.

Put sea salt which is called black or gross salt (for the ordinary white salt which is made at Volterra is not good) into the Calcar or Fornello till all the moisture be evaporated, and it becomes white, then pound it well, to a small white powder. This salt so calcin’d, keep to make a Blew or Turcois colour. Put into a small or great pot of Crystal metall died with the colour of Sea-green (made, as hath been said many ways). But let the colour be fair and full (for this is of great importance to make a fair Skie colour) according as you would have the Sea-green fair and excellent. To this metall so coloured, put of the said salt calcin’d into the pots, mixing it well with the metall, and this is to be put in by little and little until the Sea-green lose its transpa-
transparencie, and diaphanietie, and takes opacity, for the salt being vitrified makes the metall lose it's transparencie, and gives it a little paleness, and so by little and little makes the said Skie colour, which is the colour of a Turcois-stone; when the colour is enough it must be wrought speedily, for the salt will be lost and evaporated, and the metall returns again to be transparent and foul-coloured. But when the colour is lost in working add new burnt salt (as before) that the colour may be reduced, and so you shal have your desired colour. Let the Conciators well observe that this salt always crakkles when it is not well calcined, therefore let him have a care of his eyes and sight, for it endangers them. The quantity of salt must be put in by little and little, leaving some distance between each time, till he see the desired colour. But in this I used neither dose nor weight, but my eye onely. I have often made this colour, for it is very necessary in counting houses, and the most prized and esteemed colour that is in the art. Wherefore to make a Blew for counting houses, take the
The first Book.

the Green of Crystal metall, and half Sea-green made of half Rochetta, which will become a fair colour, although it be not all Crystal metall.
The second Book, wherein are shown the true ways of making Calcidony of the colour of Agats, Oriental Jaspers, with the way to prepare all colours for this purpose, and also to make Aqua-fortis, and Aqua Regis necessary in this business.

And the Manner of calcining Tartar, and uniting it with Rosichiero, made Chap. 128, which produceth pleasant toyes of many colours with undulations in them, and gives it an opacity such as the Natural and Oriental stones have.

CHAP. XXXVII.

Since I am to shew the manner how to make Calcidonies, Jaspers and Oriental Agats, it is necessary first to teach the prepa-
preparation of some mineral things, for such compositions, and although some of them may be publiquely bought, yet notwithstanding, I being desirous that the work should be perfect judged it pertinent to my purpose to shew the most exquisite Chymical way, that the skilful may make every thing of themselves, both more perfect and with lesser charge. For there is no doubt that when the materials are well prepared, and the colour of the metalls is well opened, and separated from their impurity and terrestriety which usually hinder the ingress of their tincture into glass, and their union in their smallest parts, that then they colour the glafs with lively, shining and fair colours, which very far surpass those that are vulgarly, and usually made in the furnace. And because the colour of Calcidony, or rather it's compound (which is nothing else, but as it were a reuniting of all the colours, and toyes that may be made in glafs, a thing not common nor known to all) if they be not well prepared, and subtilised as is necessary, they give not the beauty and splendor to glafs as is required. Wherefore it is necessary that the metalls be well calcined
The second Book.

cined, subtilised, and opened with the best Aqua-fortis, Sulphurs, Vitriols, sal Armoniak, and the like materials, which in length of time, and at a gentle heat, are opened and well prepared, but a violent fire herein hurteth much. Tartar and Rosichiero (besides their being very perfect and well calcined) must be also put in proportion and in fit and due time, and you must also observe, that the metall be well boiled, purifed, and perfected, and in working of it some such care is to be used, as the diligent masters are wont to use, and by thus doing the true Jasper and Agat, and Oriental Calcidionies, with the fairest and beautiful spots of wavings, and toyes, with divers lively and bright colours. Hence it truly appears that nature cannot arrive so high in great pieces, and although it is said and may be made to appear true, that Art cannot attain to Nature, yet experience in many things shews, and in particular in this art of the colours in glas, that art doth not onely attain to and equal nature, but very fair surpasses and excells it. If this were not seen, hardly would you believe the beauty, the toyes and wavings of divers colours, variously disjoynd one from the other.
other with a pleasing distinction, which is seen in this particular of the Calcidony. When the medicine is well prepared, and the glass wrought at a due time, the effect that cometh thence passeth all imagination and conceit of man. In the three ways to make it, which I teach, I believe you may see how far the art of glass ariseth in this particular, where I demonstrate every particular so distinctly, that any practitioner, and skilful person, may understand and work without error, and he that works well may find out more than I set down.

How to make Aqua-fortis call'd parting water, which dissolves silver and quick-silver, with a secret way.

CHAP. XXXVIII.

Take of Salt-peter refined one part, of Roch-alum three parts; but first exhale in pans all the humidity from it;
it; to every pound of this stuff add an ounce of Crystalline Arsnick (this is a secret and no ordinary thing) which besides it's giving more strength to the water, helps to extract, better the spirits from the materials, which are the true nerves and strength of the Aqua-fortis, without which the water perhaps would be no better than well-water. Powder and mix them well together, adding thereunto the tenth part in the whole of Lime, well powdered, mix them well, and put so much of this stuff into glass bodies, that about three quarters of them may be full, let them be luted with strong lute, which I remit to the Artist as a common thing: but one not vulgar I will declare. Take some lome for example of the river Arnus (which is a fat earth known to all) one part, of sand 3 parts, of common wood-ashes well sifted, of shearings of woollen cloath, of each one half; mix them well together, and incorporate them into a past with common water, work them well together, for the more 'tis wrought the better 'tis, therefore see that your past be a little hard, to all these add a third of common salt, with incorporate well with the lute, 'tis a business of importance,
tance, then lute the glasses with this perfect lute, and set them in wind furnaces, fitting to their bottoms, baked earth which will bear the fire. Under the bottom of these bodies, let there be four fingers of sand, & thick iron bars to bear the weight, & fill'd round about with sand, put receivers of glass to them, large and capacious within, lute the joynts well with lute made of fine flower and lime, of each a like quantity, powdered, mixed, tempered, and impasted with the whites of Eggs well beaten, with this lute, binde and lute the joynts with roulers of fine linnen, which, when well dryed and rould about three or four times, make a very strong lute, rouling but once at a time, and letting it dry a little before the second rouling. And then this will bear all the violence, fury, and force of the spirits of the Aqua-fortis, and to this end fit exactly a very large receiver to every glas body. And when they are well dryed make a fire in the furnace onely with coal at first, and that a very temperate one, for three hours, for in that time the windy moisture distilleth off, which endangers the breaking of the glasses, and continue for six hours a moderate fire, afterwards encreas
encrease it gently, adding billets of dry oaken wood to the coals, and so proceed by little and little, augmenting it for six hours more, and then the head will be tinge'd with Yellow, a sign that the spirits begin to rise; continue this degree of fire un-till the spirits beginning to condense colour Red the receiver and head, which will always grow deeper colour'd like a Rubie. Then encrease the fire for many hours, till the head and receiver become Red, which sometimes lasteth two whole days. Continue the fire by all means till all the spirits of Aqua fortis be distill'd off, which is known, when the head & receivers by little and little, begin to grow clear, and become white as at first, and wholly cold; yet notwithstanding continue the fire one hour more. Then let the furnace cool of it's self. Observe, that when the head and receivers are Red, and the fire strong, you admit no wind, nor cold air into them, nor touch them with any cold thing, for then they will easily crack, and your pains, cost and time will be lost, wherefore when they are in this state, let them be kept hot in the fire. Now, when all is cold, put up on the head and receiver linnen cloaths wetted
wetted and well soaked in cold water, that the spirits which are about the head and receiver may the better sink into the *Aqua-fortis*, leave them thus for 12 hours, then bath the joints and lutions with warm water, till they being moistened you may take off the bandage, and the head from the receiver, which usually are safe. The bodies may be broke and thrown away, for they will serve no more, powder the drags and residences of the *Aqua-fortis*, to wit, about their third part, and to every pound of them add four ounces of Salt-peter refined, and put them into another body luted, and pour on them the said *Aqua-fortis*, lute and distil them as before in every thing. Keep the *Aqua-fortis* in earthen jugs well stoppt that the better spirits may not evaporate. This parting water is good for the following uses. Some there are that instead of *Roch Alume* take as much more of the best *Vitriol*, such as the *Roman* or the like is. The sign that *Vitriol* is good for this use, is, that being rub'd upon polished Iron it colours it with a Copper colour. This *Vitriol* purified after the following manner, will make a stronger *Aqua-fortis* than *Alume*. 
To purifie Vitriol to make the strongest Aqua-fortis.

CHAP. XXXIX.

Dissolve the best Vitriol (the better, the stronger the Aqua-fortis) in common warm water, let the solution stand three days being impregnated with salt, then filtre and evaporate in glass bodies two thirds of the water, and put the remainder into earthen pans glazed, which set in a cold place, in 12 hours the Vitriol will shoot into pointed pieces, appearing like natural Crystall of a fair Emerald colour. Dissolve this same Vitriol again and do as before, and repeat it thrice, at each solution there will remain at the bottom of the glass a Yellow substance, which is it's unprofitable Sulphur, and is to be cast away. At the third time the Vitriol will be purified, and fit to make a good and strong Aqua-fortis, much stronger than the ordinary, especially if the Nitre be well refined.
How to make Aqua Regis.

CHAP. XL.

To every pound of the said Aqua-fortis, put two ounces of sal Armoniack powdered, into a glass body, which set in a pan full of warm water, and let the Aqua-fortis be often stirred, which will soon dissolve the sal Armoniack with its heat, which will be tinged with a yellow colour, put in more, sal Armoniack, as long as the Aqua-fortis will dissolve any, when it dissolves no more let it settle a little, when it is clear decant it leisurely off, and in the bottom there remains the unprofitable terrestrial of the sal Armoniack. Now this Aqua Regis is strong and fit to dissolve Gold, and other metalls; but silver it toucheth not at all.
To burn Tartar.

CHAP. XLI.

Put Tartar of Red-wine which is in great pieces, and appears full of spots (lay by that which is in powder, for it is not good) into new earthen pots, and let it burn in kindled coals until it smoaks no more, and when it is calcin'd, and in lumps of a black purplish substance then it is burned and prepared.
How to make a Calcidony in Glass very fair.

CHAP. XLII.

Put of Aqua-fortis, two pound, into a glass body not very great, but with a long neck, four ounces of fine silver, in small and thin pieces, and set them near the fire, or in warm water, which as soon as the Aqua-fortis begins to be hot 'twill work and dissolve the silver very quickly, and continue so until it hath dissolved, and taken it up, then take a pound and a half of Aqua-fortis, and in it dissolve (as you have before done with silver) six ounces of Quick-silver, when all is dissolved let these two waters be well mixed in a greater body, and pour upon them six ounces of sal Armoniack, and dissolve it at a gentle heat, when it is dissolved put into the glass one ounce of Zaffer, and half an ounce of Manganese, each prepared, and half an ounce of Ferretto of Spain, a quarter of an ounce of Crocus Martis calcin'd with Brimstone,
The Second Book.

stone, thrice calcin’d Copper, Blew smalts of the Painters, and Red-lead, of each half an ounce, powder all these well, and put one after another into the body, which then stir gently that the Aqua-fortis may be incorporated well with the said powder, keep the body close stoped for ten days, every day stirring it well severall times, and when they are well opened, then put it into a furnace on sand, and make a most temperate heat, so that in 24 hours all the Aqua-fortis may be evaporated. Observe that at last you give not a strong but a gentle heat, that the spirits of the Aqua-fortis may not evaporate, and in the bottome there will remain a Lion colour, which being well powdered, keep in a glass vessel. When you would make a Calcidony, put into a pot very clear metall and made of broken pieces of Crystal vessels, and Crystalline, and white glass which hath been used. For with the Virgin Fritt which hath never been wrought, the Calcidony can never be made, and the colours stick not to it, but are consumed by the Fritt. To every pot of about 20 pound of glass, put two ounces, or two ounces and a half, or three ounces of
of this powder, or medicine, at three times, and incorporate, and mix them, that the glass may take in the powder, in doing whereof it raiseth certain Blew fumes, as soon as it is well mixed let the glass stand an hour, then put in another mixture, and so let it alone 24 hours, then let the glass be well mixed, and take thereof an essay, which will have a Yellowish Azure colour, this proof being returned many times into the furnace, and taken when it begins to grow cold, will shew some waves, and divers colours very fair. Then take Tartar eight ounces, soot of the Chimny well vitrified two ounces, Crocus Martis calcin'd with Brimstone half an ounce, put by little and little all these well powdered and mixed into this glass at six times, expecting a little while at each time, still mixing the glass that the powder may be well incorporated. As soon as all the powder is put in, let the glass boil, and settle 24 hours at least, then make a little glass body of it, which put in the furnace many times, and see if the glass be enough, and if there be on the outside toyes of Blew, and Sea-green, Red, Yellow, and all colours with toys, and it hath
hath some waves, such as *Calcidony*, *Jaspers*, Oriental *Agats* have, and that the body kept within be as to the sight as red as fire. Now as soon as it is made and perfected, it is wrought into vessels always variegated, which are not to be remade, for they do not arise well. These vessels may be made of divers sorts, and drinking glasses of many fashions, broad drinking cups, salts, flower pots, and the like toys, still observing that the master workman pinch off well ye glass (that is wrought) with pincers, and anneal it sufficiently, that it may make waves and toys of the fairest colours. You may also make with this pot dishes, pretty large in *Oval*, *triangular*, *quadrangular* form, as you will, and afterwards work it at the wheel (as Jewels) for it takes polishing, and a fine lustre, and it may serve for little tables, and cabinets; so that those little Jewels will represent the Oriental *Agat*, *Jasper*, and Oriental *Calcidony*, and when it happens that the colour fadeth, and the glass becomes transparent, and no more Opacous as it ought to be for these works, then cease from working, put to it new *Tartar* calcin'd, foot and
The Second Book.

and Crocus, for thus (as before) it takes a body and Opacousness, and makes the colours appear; set it then to purifie many hours, that the new powder put in may be incoporated, as 'tis usual, then work it. This was my way to make Calcidony in the year 1661 in Florence, at Casino in the glass furnaces; at which time I caused to work in the furnace, the brave Gentleman Nicolao Landiamo my familiar friend, and a man rare in working Enamels at the lamp, in which furnace I made many cups of Calcidony at the same time, which always were fair to all essays, never departing from the aforesaid rules, and having the materials well prepared.
The Second Book.

CHAP. XLIII.

In a pound of Aqua-fortis dissolve three ounces of fine Silver cut small in a glass body well closed, set this aside.

2. In another glass body, put one pound of Aqua-fortis, wherein dissolve 5 ounces of Mercurie well purified, close the body well and set that aside.

3. In another little glass body, put one pound of Aqua-fortis, wherein dissolve two ounces of sal Armonack, then put into this dissolution of Crocus Martis made with Aqua-fortis, Ferretta of Spain, Copper calcin'd Red, as in Chap. 24. Brass calcin'd with Sulphur, of each half an ounce, put all these materials well ground, and powdered by themselves, and then one by one, into the bodies by little and little, with patience, because they all arise much.

4. In another little glass vessel let there be
be put one pound of \textit{Aqua-fortis}, and there-
in dissolve one ounce of \textit{sal Armoniack}, and
in the dissolution of crude \textit{Antimony} powder-
dered, \textit{Vitriol} purified, of Azure, or Blew
Smalts, of each half an ounce, one ounce of
Red-lead, grind them all well and set the
vessel by.

5. In a like body, dissolve in one pound
of \textit{Aqua-fortis}, two ounces of \textit{sal Armo-
niack}, then put in one ounce of \textit{Zaffer} pre-
pared, and a quarter of an ounce of \textit{Manganese} prepared, and half an ounce of thrice
calin’d Copper, and one ounce of \textit{Cinaber},
put in warily every one of these things
( well powdered ) by themselves, into the
body, avoiding those things that swell up
arise and fume, set this aside.

6. In another small glass body, dissolve
in one pound of \textit{Aqua-fortis} two ounces
of \textit{sal Armoniack}, and then add of \textit{Cerus},
Painters Red-lake, \textit{Verdigreas}, the Skales of
iron that fall from the anvil, of each half an
ounce, these swell very much. Let all these
6 bodies stand 12 days, & shake them well
six times every day, that the water may pe-
netrate & subtilise the ingredients and me-
ralls, to communicate their tincture to the
glass.

After
After this time take a great glass body, luted at the bottom, into which you shall empty all the materials of these six bodies by little and little, that they may not run out, nor make the glass crack; in this great body mix well the waters, that the materials may be well united, and mixed together, set this glass in ashes at a very gentle heat, for twenty four hours, that the water may evaporate. Observing that the fire be gentlest at last, lest the powder be wasted with too much heat. He that will regain the Aqua-fortis may join the head & receiver & lute the joints (as is usual) and the water being evaporated, there remains at the bottom a reddish powder, which is kept in a glass closed for use.

Put this powder or medicine into metall made of broken pieces of glass, and old glass, but not made of Virgin Fritt of Crystal, or Crystalline, as in the first Calcidony hath been said. Give the metall the same quantity, and use the said distance of time as in the other, then give it the body of burnt Tartar, and soot of the Chimney Vitrified, and Crocus Martis made with vinegar, then let them settle twenty
twenty four hours, and cause a vessel to
be made thereof, and put it in the fire,
and observe whether it take body and opa-
city, and if it shew the variety of colours
with toyes and wavings, work all of it into
vessels of divers sorts, framing there-
with all sorts of workmanship, and variety
of toyes.

With this sort of Calcidony, I made ma-
ny cups, all which were fair, and besides
with this past of Calcidony may be made
many hundred crowns for gentle men, as
fair as can be uttered. These were seen
by Ferdinando the great Duke, of blessed
memory, and by many other Princes,
and Lords, and this was done by me in
Flanders.
The third way of Calcidony.

CHAP. XLIV.

1. In a glass body in strong Aqua-fortis, dissolve four ounces of fine leaf Silver, that is to say, round cuttings of leaf silver, stop the body and set it aside.

2. In another body of like glass dissolve in one pound of Aqua-fortis five ounces of Quick-silver purified with vinegar and common salt, in a wooden dish with a wooden pestle stir the Mercury sufficiently round with strong vinegar, and wash it with clear common water, until 'tis dissolved, and carry away all the common salt, together with the blackness of the Mercurie, repeat this many times. Then strain this Mercurie through canvas, and dissolve it in the abovesaid Aqua-fortis, as before, close the glass vessel, and let it aside.

3. In another glass body, dissolve in a pound of Aqua-fortis, three ounces of fine Silver
Silver calcin'd after this manner, to wit, amalgamate the silver with Mercurie, mix the amalgama with as much more common salt well prepared from all its terrestrial, by dissolving it in common water, and boyling it a little, and then let it settle two dayes that the terrestrial mixed with the salt may sink to the bottom, then filtre the water, and in the bottom will remain the grossness and terrestrial of the salt, evaporate this water filtered from the terrestrial of the salt in a glass vessel, and dry it well, repeat this till the salt sends no more dregs to the bottom, and then it will be perfect and fit for the work. This purifying of the salt is made that it may be more efficacious to open the silver, otherwise it will be hard to separate them. Put all these things amidst the coals, in a pot, that all the Mercurie may be evaporated away, and the Silver remain at the bottom calcin'd and powdered, and add unto it its weight of new common salt prepared (as before) mix them well, and put all in a chrysible or a pot to calcine six hours in the fire. Wash this stuff in a glased pot many times with warm water till all the saltiness be well gone; then put this silver into
into a glass body full of common water, boil it till a quarter of it be evaporated, then let the silver grow cold and settle, and decant the water; repeat this fresh water thrice, and the fourth time put it in a body of *Aqua-fortis*, stir it well, and set it aside.

4. In another like body, dissolve in a pound of *Aqua-fortis*, three ounces of *sal Armoniack*, decant off the clear solution, the remainder at the bottom cast away. In this water dissolve a quarter of an ounce of gold, keep this last solution apart.

5. In another glass body, dissolve in one pound of *Aqua-fortis*, three ounces of *sal Armoniack*. Then put into the solution, of *Cinaber*, of *Crocus Martis*, of *Ultramarine*, of *Ferretto of Spain*, of each half an ounce, put them (well powdered) leisurely into the body, which being done close the vessel, and set it aside.

6. In another body, dissolve in a pound of *Aqua fortis*, three ounces of *sal Armoniack*. Then put in *Crocus Martis* calcin’d with vinegar, calcined Tin, a thing common in potters furnaces, *Zaffer* prepared, and *Cinaber*, of each half an ounce. Put gentle each of them (ground by themselves) into
into the *Aqua-fortis*, then keep this in a vessel, and set it aside.

7. In another body of glass, dissolve in a pound of *Aqua-fortis* two ounces of *sal Armoniack*. Then put leisurely into the solution, Brass calcin'd with Brimstone, Brass thrice calcin'd, as in Chap. 28. *Manganese* prepared, and the scales of Iron, which fall from the Smiths anvil, of each half an ounce. Put each of these well ground by themselves, by little and little, then close the vessel, and set it aside.

8. In another body, dissolve in a pound of *Aqua-fortis*, two ounces of *sal Armoniack*, where to put of *Verdigras* one ounce, Red-lead, crude Antimony, and the *Caput mortuum* of *Vitriol* purified, of each half an ounce, put these powdered leisurely in, close the vessel, and let it aside.

9. In another body, dissolve in a pound of *Aqua-fortis*, two ounces of *sal Armoniack*, then put in leisurely *Orpiment*, white *Arsnick*, Painters Lake, of each half an ounce, each powdered, and ground by it self, close the vessel, and let it aside.

Keep these nine bodies (well closed) in the furnace fifteen days, and every day stir it well many times, that the *Aqua-fortis*
fortis may work, and the materials be subtilised, and their tinctures well opened, else they will not well, then put all the materials with their waters into a great and strong body, by little and little; the things being united together, let alone the great body (whereunto you have poured the materials of all the lesser bodies) closed for six days, and every day stir it, then put it in ashes, giving it a gentle heat for twenty four hours, that the water may onely evaporate, observing that the body must be well luted at the bottom, even unto the midst of the body, and at the last of all the heat must be made so gentle that it onely evaporate the water, and that the better spirits of the Aqua-fortis may remain inclosed in the same powders, for to the powder will work fair, and strange things in glass. In the bottom of this body, will remain a powder of a purplish Green, whereof I gave the glass such a dose and quantity as is said in the first Calcidony. Then in due times (as is said in the first Calcidony,) give it its body, to wit, Tartar burnt, the foot of the Chimny, and Crocus Martis made with vinegar, using the same dose, and diligence, times, and 

G 2
The second Book.

intervals throughout, as is said in the first Calcidony, then at the end of twenty four hours, work it with diligence, and according to art, and set it to the fire again, as hath been most punctually said in the first Calcidony.

This third way of making Calcidony, I performed at Antwerp, a City of Brabant, Anno 1609. in the Moneth of January. At which time, and for many years, there was in the house Signor Emanuel Nimenes a Knight of the Noble Religion of Saint Steven, a Portuguese, and Citizen of Antwerp, a gentile Spirit, and Universal in all knowledge, as any in the Low-Countries, whom I saw or knew. With this powder I made a Calcidony in the furnace of Antwerp, which I caused Signor Philippo Ghiridolfo a very Courteous Gentleman to work, which Calcidony came forth so fair, and beautiful, that it imitated the true Oriental Agat, and in fairncs and beauty of colours far surpassed it. Many Portugal Gentlemen well Skilled in Jewels admired it, saying, that nature could not do more. This was the fairest Calcidony that ever I made in my life, which al-
The second Book. 85

though it be laborious, and long a working, yet notwithstanding it doth real things. Of this Calcidony two vessels were given to the most Excellent Prince of Orange, which pleased him very well.
The third Book. This Book shews the wayes to make the colour of Gold Yellow, of the Amethyst, Saphyre, Granat, Velvet Black, Milk White, Marble, and Deep Red; As also to make Fritt with natural Crystal, and to colour glass of a Pearl colour, and other particulars necessary in this Art.

CHAP. XLV.

This third Book teacheth various wayes, and one better than another, to make all the abovesaid colours; As al-
so a particular way to make Fritt of natural Crystal, which will melt as ordinary Crystal metall, and will make vessels very white, beautiful, and sightly. There is no doubt but some of those colours are known to Artists, though not to all persons. For few they are that know how to make well Gold Yellow, and a Deep Red, being hard and nice colours in this Art. Since in making them 'tis necessary you be punctual in the dose, time, circumstances, and materials: for if you err but a very little in any of them whatsoever, all the whole labour and business is lost and comes to nothing. I describe these two colours, and all other, in so clear and intelligible a stile, that every body may understand, and make them to their gust and satisfaction.

You must be exact in the time, quantity, circumstances, purifying, powdering, scouring, fire, materials, if you err but a little in any of them whatsoever, all the labour is lost, and the colours come to nothing.

2. Tartar must be of Red-wine well vitrified in the vessel, in gross pieces, not in powder. Vitrified naturally of themselves. That of white wine is not good.

3. To Manganese our author still subjoyns of Piemont.

4. The
The third Book.

4. The colour must be made fuller or lighter according to the works you employ them for, and to heighten them, put in more of the colour, but to make them lighter, put into the pot more Fritt. Take some metal out of the pot, and you shall see whether you have your desired colour; put in your colours by little and little lest they overdo.

5. Put your colour to the Fritt, and not to the metal, when melted, for then it neither takes the colour so well, nor so good a colour.

6. Mix the colours well with the metal in the pots, when 'tis melted, that both may be well incorporated, and this is to be done as often as you work the metal.

To make a Gold Yellow in glass.

CHAP. XLVI.

Take Crystal Fritt two parts, Rochetta Fritt one part, both made with Tarso, (which is much better than sand) mix and remix well these two Frits, and to every hundred pound of this composition, take of
of Tartar in lumps well beaten and forced fine, of Manganese prepared, of each one pound, mix these two powders well, first together, and then with the Frits. Then put them into the furnace, and let them stand four days at an ordinary fire, because they rise much. When the metall is purified and well coloured (which usually is at the end of four days) work it into vessels and works. This quantity of the materials makes a most fair colour, which you may make deeper or lighter by adding or diminishing the powders or Frits. You must put the powder in at several times, and not into the metall, for then it colours not. With these rules and observations you shall make a very fair Gold Yellow. But if you would have it fairer and a more graceful Yellow, take all Crystall Fritt. And thus I have frequently made this colour and always very fair.
Garnat colour.

CHAP. XLVII.

Take of Crystall and Rochetta Fritt, of each a like quantity, mix them well, and to every 100 weight, add of Manganoese one pound, Zaffer prepared an ounce, mix well these two powders together first, then with the Frits, then put this powder into the pot by little and little. Mix well the Manganoese with the Zaffer, for this quickens the colour, making it shining, beautiful and fair. At the end of 24 hours (when 'tis pure and well coloured) work it.
CHAP. XLVIII.

Take only Crystal Fritt made with the most perfect Tarso, Manganese prepared one pound, Saffier prepared one ounce and a half, mix these two powders well together, and then with the Fritt, and not with the metall in the pots. The proportion is one ounce of the mixed powder to one pound of the Fritt. When the metall is pure and well coloured work it into vessels, &c.
Saphyre colour.

CHAP. XLIX.

To every hundred weight of Rochetta Fritt, add one pound of Zaffer prepared, & to every pound of Zaffer one ounce of Manganese, mix these two well together first, and then with the Fritt, put them all mixed into the furnace to melt and purifie, and when 'tis pure, and well coloured work it, &c. This small quantity of Manganese makes a most fair colour of a double violet, which I have often made at Pisa and always well.
A fairer Saphyre colour.

CHAP. L.

Instead of Rochetta Fritt, take Crystal Fritt, where to add the same quantity of the foresaid powder, with the same rules, and you shall have a fair, and shining Saphyre colour.

A Black colour.

CHAP. LIII.

Take pieces of broken glasses of many colours, grind them small, and put to them Manganese & Zaffer, to wit, not more than half of Manganese to the Zaffer. This glass purified will be of a most fair Black, shining like velvet, and will serve for tubes and all kindes of works.
A much fairer Black.

CHAP. LII.

Take of the Frits of Crystal and Polverine, of each 20 pound, Calx of Lead, and Tin four pound, mix all together, let them in a pot in the furnace well heated, and when the metall is pure, take steel well calcined and powdered, scales of Iron which fall from the Smiths anvil, of each a like quantity, powder and mix them well, put six ounces of this powder to the said metall that they may both strongly boil, let them settle 12 hours, and sometimes mix the metall, and then work it. This will be a most fair Velvet Black, and pleasant, to make all sorts of works.
Another fairer Black.

CHAP. LIII.

To a hundred weight of Rochetta Fritt, give two pound of Tartar, and of Manganese six pound, both pulverised, mix them and put them in the furnace leasurely, let the metall purifie, which will be about the end of four dayes, then mix, and wash the said metall, which will make a more marvellous black than all the former.
A fair milk White called Lattimo.

CHAP. LIV.

TAke of Crystal Fritt twelve pound, of calcined Lead and Tin two pound, mix them well, of Manganese prepared half an ounce; unite them all together, and put them into a pot heated, let them stand twelve hours that the materials may be melted, and at the end of eight hours you may work it. This will be a fair White which I have often made.
A fair White much whiter than the former.

CHAP. LV.

Take 400 weight of Crystal Fritt, and 60 pound of calcined Tin, and two pound and a half of Manganese prepared, powder and mix them all with the Fritt, and set them in a furnace in a pot, let them refine, and at the end of 18 hours this stuff will be purified, which cast into water, purifie it again in the furnace, and make a proof, and if it be too clear add 15 pound of the aforesaid calcined Tin, mix well the metall many times, and at the end of one day it becomes marvellous white, and in whiteness surpasseth any snow, then work it. I have often made it and always with good success. This white may be also made with Rochetta, but not so white as with Crystal.
To make a Marble colour.

CHAP. LVI.

Put Crystal Fritt in a pot, and when 'tis melted (before 'tis purified) work it. This is a fair Marble colour.

A Peach colour in White.

CHAP. LVII.

Manganese prepared will make in Lattimo the colour of a Peach-flower. But work it in time because it loseth colour.
A Deep Red.

CHAP. LVIII.

TAke of Crystal Fritt 20 pound, broken pieces of white glass one pound, calcined Tin two pound, mix these well together, put them into a pot to run and purifie, when these are melted, take Steel calcined, scales of Iron from the anvil, both well ground, of each a like quantity, mix them together, put leisurely of this mixture, about an ounce, to the aforesaid metall when purified, and mix them well, and let them incorporate, which succeeds commonly in five or six hours. Too much powder makes the metall black, whereas the colour ought to be transparent and not opacous, of an obscure Yellow; when 'tis so, put in no more powder, but then put about three quarters of an ounce of Brass calcined to redness (as in the 24 Chap.) and ground, to
The third Book.

101
to this metall, and mix them many times, and at about three or four times it will become as red as blood, wherefore make essays often, and see whether this colour be good, and when so, work it speedily, else 'twill lose it's colour, and become black. Besides leave the mouth of the pot open, else the colour will be lost. Let not the pot stand above 10 hours in the furnace, and suffer it not to cool as much as is possible. When you see the colour fade (which sometimes happens) put in some scales of Iron, which reduceth the colours. And, because this is a nice colour, use all diligence in making it by putting in the steel and scales, as also in working it.
Fritt of natural Crystal.

CHAP. LIX.

Calcine natural Crystal in a Chrysible, extinguish it in common cold water eight times, cover the Chrysible that no ashes nor filth get in, Dry the calcined Crystal, and grind it to an impalpable powder, mix this powder with salt of Poverine made in a glass body, as in Chap. 3. with these make a Fritt, observing the quantities, rules, and portion of Manganese, setting it in the furnace, & at due, and often times casting it into the water, purifying and working it as in other Crystal. And thus you will make a marvellous thing.
A Pearl colour in Crystal.

CHAP. LX.

Put at 3 or 4 times to Crystal melted and purified, of Tartar well calcin'd to whiteness, and continue to put in the Tartar 4 or 6 times, always mixing it well with the metall, till the Crystal hath gotten a Pearl colour. Then work it speedily, for this colour fadeth. This I have often practised and experimented.
The fourth Book. Wherein is shown the true way to make glass of Lead, to calcine Lead, and extract from it the colours of green Emerald, Topaz, Skie colour or Sea green, Granat colour, Saphyre, Gold Yellow, and of Lapis lazuli.

With the way to colour natural Crystal (without melting it) into the permanent colours of Rubies, Balas, Topaz, Opal, Girasole, & other fair colours.

CHAP. LXI.

The glass of Lead known to few in this Art, as to colours, is the fairest and noblest glass of all others at this day made in
in the furnace. For in this glass the colours imitate the true Oriental gems, which cannot be done in Crystal, nor any other glass. 'Tis very true, that unless very great diligence be used, all sorts of pots will be broken, and the metall will run into the coals of the furnace. Observe my rules in all these glasses made of Lead exactly, and you shall avoid all danger. This business principally consists in knowing well how to calcine Lead, and to recalcine it also a second time; For by how much 'tis better and more calcined, by so much the less it returns to Lead; Again, and by consequence the less breaks out the bottom of the pot. Secondly, cast the metall into water, and separate carefully the Lead from the glass, even the least grains of it. This glass of lead must be cast into the water by little and little, to make a better separation, for the least Lead remaining breaks out the bottom of the pots, and lets all the metall run into the fire.

These two rules our Author repeats almost in every Chapter of this Book, and these following also,

The pots and Lead must not have too much heat in the furnace, neither must the metall
metall be wrought too hot, and the Marble whereon 'tis wrought must be of the hardest stone, and must be wetted, else the marble will break and scale.

To calcine Lead.

CHAP. LXII.

At first Calcine Lead in a Kil as the potters do, and in great quantity. Usually in two days they calcine many a hundred pound of Lead. In calcining observe that the Kil be not too hot, but sufficiently heated only to keep the Lead in fusion, for otherwise 'twill not be calcin'd. When the Lead is melted it yields at the top a Yellowish matter. Then begin to draw forwards the calcined part with an Iron fit for the purpose, always spreading it in the internal extremity of the Kils bottom, which should be of soft-stone, which will bear the fire. And the Kil must have a declivity towards the mouth, which I pass by as a thing well known. When 'tis calcined once it must be put, and spread
spread a second time in the Kil, to reverberate in a convenient heat, always stirring it with an Iron, and that for many hours, till it come this second calcination to a good Yellow and be calcined. Then force all in a fine force, and what passeth not the force recalcine it with new Lead. This is the way to calcine Lead in great quantity to make thereof store of Potters ware.

To make glass of Lead.

CHAP. LXIII.

Take of this calcined Lead 15 pound, and Crystall or Rochetta or Pulverine Fritt, according as you would make the colours, 12 pound, mix them as well as possibly you can, put them in a pot, and at the end of 10 hours, cast them into water, for by that time they will be all well melted, separate the Lead, and return the mettal into the pot, which in 12 hours at most you shall have most fit to work.
The manner how to work the said glass.

CHAP. LXIV.

To work glass of Lead into divers drinking or other vessels, 'tis necessary before 'tis taken upon the Iron to be a little raised in the pot, and then take it out, and suffer it to cool a little, and then work it on the Marble being clear. At first let the Marble be well wetted with cold water that this glass may not draw away with it the Marble, and scale it; which it always doth when the marble is not wetted, and incorporates it into itself. This sticking of the marble makes a foul colour in the works. Wherefore continually wet the marble whiles this glass is wrought, otherwise all the fairness and beauty will be taken from it. Do thus as often as you take the metall out of the pot. This sort of glass is so tender, that if it be not cooled in the furnace, and taken a little at a time, and held on the Irons, and the Marble continually wetted, 'tis
The fourth Book.
'tis impossible to work it. Which proceeds from the calcined Lead, which makes it most tender as a caudle.

Glass of Lead of a wonderful Emerald colour.

CHAP. LXV.

Take of Polverine Fritt 20 pound, Lead calcined 16 pound, force these two powders first by themselves, then, when well mixed, put them in a pot not too hot, and at the end of 8 or 10 hours they will be melted, then cast them into water, and separate the Lead. Put them a second time into the pot, and in 6 or 8 hours they will be melted, then cast them into water and separate the lead. This being twice done the metall will be freed from all the Lead, and all the unctuosity which calcined Lead and Polverine give it, and will acquire a most bright and shining colour, and in few hours 'twill run and become very clear, then give it brass thrice calcined (made as in Chap. 28.) six ounces.
The fourth Book.

ces; and therewith mix a peny weight of Crocus Martis made with Viniger, put in this mixture at six times, alwayes mixing well the glasse, and taking at each time the intervall of saying the Creed. Let this glasse settle an hour, then mix and take a proof thereof. When you like the colour let them incorporate 8 hours, then work them into drinking glasses, which will appear in a colour proper to the Emerald of the old Oriental rock, with natural shining and glittering.

Let this glass stand in a pot when sufficiently coloured, till it hath consumed all the dregs, and till it be perfectly refined, and then 'twill be so like the natural Emerald that you can hardly know one from the other.
Another wonderful Green Emerald beyond all other Greens.

CHAP. LXVI.

This is made in every thing as the Emerald-green, in Chap. 65. but with this difference, that this onely takes six ounces of the powder of the Caput mortuum of Vitriolum Veneris, made as in Chap. 131, 132, and the other the same quantity of Brass prepared. This happily is the rarest Green that can be made any way whatsoever, which I have often made to my content.
Topaz colour in glass of Lead.

CHAP. LXVII.

Take Crystal Fritt instead of Pulverine Fritt 15 pound, Lead calcined 12 pound, mix and serve them both together, set them in the furnace not too hot, at the end of 8 hours, cast them into water, separate the Lead from the pot and glass, and repeat this twice, then hereto add half glass of a Gold Yellow colour, let them incorporate, and purifie for an Oriental Topaz.

A Sky or Sea-green in glass of Lead.

CHAP. LXVIII.

Take Crystall Fritt 16 pound, Lead calcined 10 pound, mix and serve them well together, set them in the furnace, in
12 hours the stuff will be melted, cast both it and the pot into water, separate the lead, let them stand in the furnace 8 hours a second time, then cast them into water a second time, and separate the lead, put them in the furnace, and in 8 hours your metall will be most clear, then take of Brass calcined 4 ounces, of Zaffre prepared a quarter of an ounce, mix these well, and put in this mixture at 4 times to the glass of lead, and at the end of two hours mix well the glass and take a proof, then let the glass stand 10 hours, in which time the colours will be well incorporated, and the glass be very well perfected, and be fit to be wrought in any works.

The colour of a Granat in glass of Lead.

CHAP. LXIX.

Mix 20 pound of Crystall Eritt with 16 pound of calcined lead,erce and put them into a pot, and to them of Manganese three ounces, of Zaffre half an ounce, both prepared, let them stand 12 hours
hours, cast them into water and separate the lead, put them again into the furnace, and let them purifie 10 hours, then mix them, and take a proof, when the colour is perfect, and of a fair Granat, work the glass as before.

Saphyre colour in glass of Lead.

CHAP. LXX.

Take 15 pound of Crystal Fritt, and lead calcined 12 pound, mix and serce them well together, then add to them two ounces of Zaffer, and of Manganese a peny weight, both prepared, let them stand in the furnace 12 hours, cast them into water, and separate the lead, repeat this a second time, and you shall have the colour of an Oriental Saphyre, very beautiful and fair, with the mixture of a double Violet colour.
A Yellow Gold colour in glass of Lead.

CHAP. LXXI.

Take of Crystall Fritt, and calcined lead, of each 16 pound, mix and seare them well, and add to them of Brass thrice burn'd six ounces, Crocus Martis made with Vinegar 2 peny weight, put them well mixed in the furnace, let them stand 12 hours, then cast them into water, separate the lead, let them in the furnace other 12 hours, and in that time 'twill be clear, mix them and take a proof. If it wax green, give it a little Crocus Martis (which takes away the greeness) till it become a most fair Gold Yellow colour, often made by me.

The colour of Lapis Lazuli.

CHAP. LXXII.

Melt the fairest Lattimo made, as in Chap. 55, with the whitest Crystall and most tender, in a pot, when 'tis well
well melted, give it of Blew Painters Smalts, by little and little, and when the colour is good, let it stand in the fire two hours, and make a proof, and when 'tis good let it stand 12 hours, mix them, and work them. If the metall rise put in a piece of leaf Gold to diminish the rising. This will be very like the natural Lapis Lazuli.

The way to colour natural Crystal of a Viper colour, without melting it.

CHAP. LXXIII.

Take natural Crystal of a good water, and very clear, free from Terrestriety, in several pieces of divers Magnitudes, crude Antimony, Yellow Orpiment of each powdered two ounces, sal Armoniac one ounce, powder and mix well these three last, put this mixture in the bottom of a Chrysible that will bear the fire, and above this mixture the Crystalls in pieces, then cover this Chrysible with another, mouth
to mouth, lute them well, and when they are dry, set them in coals, which kindle by little and little, and when they begin to fire, let them flame of themselves, and then they will smoke much, do this operation in a large Chimney, and avoid the dangerous and deadly fumes, when all these fumes are gone, let the Chrysible stand till the pot cool, and the fire go out of its self. Then unlute the Chrysibles, and take out the pieces of Crystal, and those which are at the top will be tinged with a good Yellow colour, with a red Rubie, and Balas colours with fair spots, those which lay at the bottom upon the powder, and the residence, into the Wavie colour of a Viper. These pieces of Crystall may be wrought as Jewels at the wheel, and will receive a good polishing, lustre and shining beauty, such as is in the Topaz, Rubie and Balas, if you give them foils suitable to their colour they make a fair shew, being set in Gold. Of these Crystals you may colour a good quantity, since the charges and labour is but small, and in colouring a competent quantity there always come forth some beautiful and fair.
The colour of a Balass, Rubie, Topaz, Opal, and Girasole in Natural Crystall.

CHAP. LXXIV.

Take Orpiment of a Yellow-oringe-tawney colour in powder, Crystalline white Arsnic, of each two ounces, crude Antimony, sal Armoniac, of each one ounce, put this powder well mixed, into a very capacious Chrysible, and upon the powder, scales, and little pieces of Crystall, and upon these small pieces larger and grosser pieces of Crystall of a fair water, without spots, if you would have a pleasing thing, let them be very large. And so fill the Chrysible, to which lute well another mouth to mouth, make a hole at the bottom of the uppermost of the bigness of a Tare, that the air may draw thorow this hole the fumes of the materials which pass thorow the pieces of the Crystal.

Which
The fourth Book.

Which tingeth the Crystall well, and better than when they pass thorow the joynts of the Chrysibles. When the lute is dryed, set them in the coals, so that all the lower most, and half the uppermost be buried in the coals. Then kindle the fire by little and little, do as in the former, and avoid the deadly fumes. The materials fume long, keep constantly a strong, and good fire. See you let not in any wind or cold air by windows or other places, for the pieces of Crystall being then hot, will become brittle, will split, and not be good. When the fire is gone out of it's self, unlute the Chrysibles, and you shall find the greatest part of the Crystall tinged with the true colours of Topaz, Chrysolite, Balass, Rubies, Girasole, and Opal with wonderful beauty. Those of the best colour may be wrought by the Jewellers, at the wheel, and appear natural jewels, and the Crystall holds it's natural hardnes, which is great. At Antwerp I made good store, and amongst them, some of them were of a fair Opal colour, and some of the Girasole. You may set them in Gold with foiles. Be sure
sure the Orpiment be good, for therein consisteth all the secret. If the work proceeds not well the first time, repeat it a second, and with practice you shall always do it without failing.
The fifth Book. Wherein is shown the true way to make pasts for Emeralds, Topas, Chrysolite, Iacinth, Saphyre, Garnat, Egmarine, and other colours, of so much pleasantness and beauty, that they surpass the same natural stones in all things, except hardness.

With a new Chymical way (never yet used) to make the said pasts, taken out of Isaac Hollandus, and far excelling all other pasts that have been hitherto made, both in beauty & colour.

CHAP. LXXV.

I believe there are few who desire, and seek not with all earnestness the knowledge
The fifth Book.

ledge to imitate perfectly Emeralds, Topaz, &c. And in a manner all sorts of Jewels, which in colour, splendor, pleasantness and clearness, excepting hardness, excel the natural and Oriental, a thing very delightful and pleasant.

Wherefore in this present Book I describe the means to make them, with the circumstances and diligence necessary to be used. There is no doubt but he who shall set himself to the work with diligence, shall do much more than what I publish. The way lately practised by me, and taken from Isaac Hollandus, maketh pasts of incredible, and seemingly impossible beauty and perfection. 'Tis true the work is somewhat long and wearisome, yet I that have many times performed it, say 'tis very facil and plain, and (that which is above all) this way is true. Wherefore all pains, expences, and charges employed in such a like work, ought to seem small and light.
The way to prepare natural Crystal.

CHAP. LXXVI.

Take natural Crystal the clearest that is possible, and put by firestones, Calcidonies, and Tarso and other hard stones, which though they Vitrifie, yet they make not so clear, lucid and shining stones as natural Crystal doth. The said stones used to make counterfeit Jewels, though they take polishing wonderfully, yet they always have something earthy, and obscure in them. But Crystal hath always something, that's aerial and transparent, and draweth near to the quality and nature of Jewels, especially those which are natural and Oriental. For they work far greater effects than the Italian or Dutch. Take then works made of Crystal, put them in Chrysibles covered at the top, set them in burning coals till they be both well heated & fired, then suddenly cast the Crystal into a very large pan, full of cold clear water. When the Crystal is cold recalci...
cine, and heat, and cast it into fresh clean water, repeat this 12 times, and be sure the ashes and filth be kept out of the Chrysfible, and that the water be always very clean. When the Crystal is well calcined grind it to an impalpable powder as fine as the best wheaten flour, and that on a Porphyrie-stone, with a muller of the same, and then 'twill crumble and come to a flour, like refined sugar. If you powder the Crystall in Brass mortars, with an Iron Pestle, you can make nothing therewith but a green Emerald colour. Grind not above a spoonful at a time, and this grinding, and fering must be often repeated, so long till no roughness remains, nor can be felt in the powder. For otherwise a past made thereof will give onely a durtty and imperfect work, and will never be like natural Jewels. But if the Crystall be well ground 'twill make artificial gems, far excelling true natural stones in beauty, colour, clearness, splendor and polishing. Make a good quantity of this material that you may make all colours, for this is the prime material to make all Artificial jewels, and shall be called hereafter Crystal prepared.
The fifth Book.

These rules often repeated by the Author take together.

1. That the whole be done cleanly, to this end lute all the pots wherein the Crystal is calcin'd, and wherein the pasts are baked with lute well dryed, before they be set to calcine or bake.

2. Take pots that will bear the fire.

3. Grind all on Porphyrie-stone, and not in metal, to a most implapable powder, first singly, and then together.

4. Keep a just proportion in the dose of the Ingredients.

5. Mix the materials well before you bake them, and if the past be not sufficiently baked the first time, bake it again a second time in the potters furnace, and never break the pot till you see 'tis baked, for if you do the pasts will be foul, and full of blisters.

6. Leave the vacuity of a fingers thickness in the top of the pot, especially where 'tis said it swells much, or that you must put it in leasurely, lest the materials run out into the fire, or stick to the cover, and so make a foul colour.
How to make Oriental Emeralds.

CHAP. LXXVII.

Take of Crystall prepared two ounces, ordinary Red-lead four ounces, mix and incorporate them well together, good Verdigrees two peney weight, Crocus Martis made with Vineger eight grains, Mix all well and set them in a potters furnace, in the hottest place thereof, as long as the fire lasts. To see whether the past be sufficiently baked and purified, clear and transparent, take onely off the cover made of lute, and if the past be pure and transparent to the bottom 'tis a sign 'tis baked enough. Otherwise relute, and bake it again, without breaking the pot, for then the past will be full of points and blisters. Let the fire be continued 24 hours with dry wood.

I set up a furnace at Antwerp a purpose, wherein I kept 20 pots of divers colours, and with a fire in 24 hours melted and purified all of them, and to be the more secure, continue the fire six hours more,
and by this means the past will be very well baked, and little wood wasted. These pasts may be cut and wrought, in every thing, as ordinary Jewels, they wholly receive the same polishing and lustre, and are set in Gold with foiles, as the other commonly are. This past is harder than ordinary.

---

To make a deeper Emerald colour.

CHAP. LXXVIII.

Take of Crystall prepared an ounce, of Ordinary Red-lead six ounces and a half, mix them, and add, of Verdegreas about three peny weight, and 13 grains, of Crocus Martis made with vineger 10 grains. Proceed according to the rules, and you shall have a marvellous Emerald colour for small works, and to be set in Gold. This past must be baked more than ordinary, to wast that imperfection which Lead usually gives; this past is britler, but fairer than the former.
To make a more beautiful past for Emeralds.

CHAP. LXXIX.

Take of Crystall prepared two ounces, Ordinary Red-lead seven ounces, mix and add to them of Verdegreas about ten grains to every ounce, and of Crocus Martis made with Vinegar ten grains onely at a time, mix them and proceed according to rule, and you shall have an Emerald past for small works, very fair and beautiful, but not hard, by reason of the plenty of lead. Wherefore bake it more than ordinary to take away the blackness, and unctuosity Lead naturally yields.
Another most fair Emerald.

CHAP. LXXX.

Take of Crystall prepared two ounces, ordinary Minium six ounces, mix them, and add of good verdigees well ground 80 grains, mix and bake them for a most fair Oriental Emerald.

An Oriental Topaz.

CHAP. LXXXI.

Take Crystall prepared two ounces, ordinary Minium seven ounces, mix them, and bake them, for a marvelous Oriental Topaz, to work any kind of work you please.
An Oriental Chrysolite.

CHAP. LXXXII.

Take of prepared Crystall two ounces, ordinary Minium eight ounces, mix them, and add of Crocus Martis made with Vineger 12 grains, mix and bake them more than ordinary by reason of the great quantity of lead.

Sky colour.

CHAP. LXXXIII.

Take of Crystall prepared two ounces, ordinary Minium five ounces, mix them, and add 21 grains of Zaffer prepared and ground, remix and bake them for a most beautiful Sky colour.
A Sky with a Violet colour.

CHAP. LXXXIV.

Take of Crystall prepared two ounces, ordinary Minium four ounces and a half, mix them, and add about four grains of Painters Blew smalts, mix and bake them, this past will be a most fair Violet, and pleasant Sky-colour.

An Oriental Saphyre.

CHAP. LXXXV.

Take of Crystall prepared two ounces, ordinary Minium six ounces, mix them well, and add of Zaffer prepared five grains, mix with the Zaffer of Manganese prepared seven grains, remix and bake them for an Oriental Saphyre, which will have a most beautiful Violet colour.
A deep coloured Oriental Saphyre.

CHAP. LXXXVI.

Take of Crystall prepared two ounces, ordinary Minium five ounces, of Zaffer prepared about 42 grains, add to the Zaffer of Manganese prepared eight grains, mix and bake them well, and they will make a deeper Oriental Saphyre, with a Violet colour of notable fairness.

An Oriental Garnat.

CHAP. LXXXVII.

Take of Crystall prepared two ounces, ordinary Minium six ounces, mix them and add about 16 grains of Manganese prepared, wherewith mix three grains of Zaffer prepared, mix them all together, and bake them for a most fair & sightly Garnat.
A Deeper Oriental Garnat.

CHAP. LXXXVIII.

Take of Crystall prepared two ounces, ordinary Minium five ounces and a half, of Manganese prepared 15 grains, where-with mix four grains of Zaffer prepared, mix them all, this swells much, bake them for an Oriental Garnat, which hath in it a very fair Violet colour.

Another fair Garnat.

CHAP. LXXXIX.

Take of Crystall prepared two ounces, ordinary Minium five ounces, mix them, and add 52 grains of Manganese prepared, where-with mix six grains of Zaffer prepared, mix them all well and bake them for an Oriental Garnat fairer than any of the former.
Observations for Pastes and their colours.

CHAP. XC.

Observe, that the colours in the aforesaid pastes, may be made deeper, or lighter, according to the works they are to be used for, and also the will and humour of the maker. Small stones for rings, pendants, and ear-rings require a fuller, but greater stones, a lighter colour. No rules can be herein given, though those given by me will give some light to the curious Artist, to whose judgement it must be left, and who may find out and invent more and better colours. Besides I set down here only colours from Verdigrease, Zaffer, and Manganese. But a curious person and practical Chymist may extract a wonderful Red from Gold, and another fair Red from Iron, from Brass an exceeding fair Green, from Lead a Gold colour, from Silver a Sky-colour, and a much fairer from Granats of Bohemia, which are low-priz'd,
for being small you may draw a tincture from them, as I have often done in Flanders, and this doth notable effects. The same may be done with Rubies, Saphyres and other Jewels. To write of these things would be a business too long for me, who speak so clearly in this present work. But the colours abovesaid will make pleasant works.

The way to make the abovesaid Pastes, and to imitate all sorts of Jewels, marvelous and never used.

CHAP. XCI.

This way which I have taken from Isaac Hollandus, when I was in Flanders, to imitate Jewels, is not much used, and known perhaps to few persons, and though it be somewhat laborious, Yet by how much 'tis more laborious 'tis so much the fairer; and beautiful, than any made in any place whatsoever to this day, or at least
least not shewn to me by any person. Wherefore I will shew the manner to make them, so clearly, and with so many circumstances and observations, that any one versed in Chymistry will be easily capable thereof, and will do the work perfectly. Take Ceruss, otherwise call'd white lead, grind it very fine, and put it into a great glass body, and pour therein as much distil'd Vineger as will rise a palm above it. Observe that at first the vineger boils and swells, wherefore put it in by little and little, till all the fury and noise is gone. Then set the Vineger on a hot furnace in sand, and evaporate away the eighth part of it, take it from the fire, and when the body is cold, decant leisurely the Vineger coloured enough, and impregnated with salt, which set aside in a glass vessel, then pour more fresh distil'd Vineger on the Ceruss, and evaporate and decant as before. Repeat this till you have extracted all the salt from the Ceruss, which is when the Vineger is coloured no more, nor hath any more taste of sweetness, which usually succeeds the sixth time. Then Filtre these coloured Vinegers
gers mixt together, evaporate and dry them in a glass body, and the salt of Lead will be at the bottom of a white colour. Which set in sand in a glass body from the neck downwards well luted, but the mouth of the glass must be open, and the furnace heated for twenty four hours continuance. Then take the salt out of the receiver, powder it, and if it be Yellowish and not Red, set it twenty four hours in the fire, till it become as Red as Cinaber. Make a good fire, but not to melt it, for then all your labour and pains will be lost. Pour distilled Vineger on this Red-lead calcin'd, repeating this work as before till you have extracted all the salt from it, and separated all the dregs and terrestriety in whole or in part. Keep these coloured Vinegers in earthen pans glazed six days, that all the terrestriety and imperfection may sink to the bottom. Then Filtre them, leaving the grosser part at the bottom as unprofitable, then cover the Vinegers in a glass body, and there will remain at the bottom a most white salt of lead, and sweet as Sugar, which dry well
well and dissolve in common water, let the solution stand six days in glazed pans, separate the terrestriety at the bottom, Filtre and evaporate as before, and there will remain at the bottom of the glass a salt as white as snow, and sweet as Sugar, Repeat this Solution, Filtration, and evaporation thrice. This salt is called Saccharum Saturni. Which put into a furnace into a body of glass in Sand, and at a temperate heat for many days, and it will appear calcin'd into a colour much redder than Cinaber, and as subtile and impalpable as the finest forced wheaten flour. This is call'd the true Sulphur of Saturn purified from all terrestriety, foulness, and blackness which Saturn had at first in itself. Now when you would make pasts for Emeralds, Saphyres, Garnats, Topaz, Chrysolite, Sky or any other colour, take the same materials, colours, quantities as abovesaid in the former receipts, except that instead of ordinary Red-lead, you shall take Sulphur Saturni, working exactly in every thing as before And you shall have Jewels of marvelous fairness in all colours, which very
far surpass the forementioned, made with ordinary Red-lead. For this true Sulphur *Saturni* outgoeth all others, more than I write thereof, as I have seen, and often made it at Antwerp. Pastes made with this Sulphur, have not that unctuosity and Yellowness, as the other ordinary ones have, which in time shew their foulness, and the moisture and sweatiness which coming from within men much soil them, which happens not to those made with the said Sulphur. Wherefore think not that pains much, which will be well recompensed with the work and effect.
How to make very hard past of all colours.

CHAP. XCII.

Take of prepared Crystall ten pound, salt of Polverine six pound, made as in Chap. 3. well dryed and ground on a Porphyrie, mix and serce them well together, sulphur Saturni two pound, mix these three powders in earthen pans glazed and clean, and with a little common water make with them a hard past, and of the past little cakes, each weighing three ounces, with a little hole in the midst of them, dry these in the sun, & then calcine them in the highest part of the potters furnace, or in other like fires, then powder and grind these cakes on a porphyrie, and serce them fine, then set them in pots in glass furnaces, to purifie three days, and cast them into water, and return them to the furnace for 15 days to purifie, that all the foulness and blisters may vanish, and the past remain most pure, like natural Jewels. And
moreover this sort of purest glass will be tinged into all colours you desire. For example into an Emerald with Brass thrice calcin'd, as is done in ordinary glass, into a Sea-green, with Brass calcin'd to redness, made as in Chap. 24. and with Zaffer into a Topaz, into a Saphyre with Manganese and Zaffer, into Yellow with Tartar & Manganese, putting them in by parts, and into a Garnet also, with Manganese and Zaffer dividedly put in. And indeed this past imitates all Jewels and colours, and hath a wonderful shining and lustre. And in hardness too it imitates the jewels, Especially the Emerald, which will be made most fair and almost as hard as the true.
The sixth Book. Wherein is shewn the way to make all the Gold-Smiths Enamels, to Enamel upon Gold in divers colours, with rules, and the materials which colour, and what fires make those Enamels, with exact diligence and clearest demonstration possible.

Enamelling on Gold and other metals is a fair and pleasing thing, and in it's self not only laborious, but necessary, since we see metals adorned with Enamels of many colours make a fair and noble shew, enticing beyond measure the eyes of the beholders. And because 'tis one of the most principal, and a most necessary part of glass, and it appear-
The sixth Book.

ing to me to be a thing grateful and pleasing to all, I set myself to describe many ways to make several sorts of Enamels, as a thing not vulgar, and belonging to this Art, and one of its most noble Appurtenances. And that this work might not be deprived of a matter so pleasant, profitable and necessary, I have made this sixth Book for the delight and benefit of all.

The Material wherewith all Enamels are made.

CHAP. XCIII.

Take of fine Lead 30 pound, of fine Tin 33 pound, Calcine them together in a Kil, and searce them, Boil this Calx a little in clean water in clean earthen vessels, take it from the fire and decant off the water by inclination, which will carry with it the finer part of the Calx, put fresh water on the remainder, then boil and decant as before, repeat this as long as the water carries off any Calx.

Recal-
Recalcine the gross remaining Calx, & then draw off again the more subtile parts, as before. Then evaporate the waters which carried off the finer Calx at a gentle fire, especially at the last, that the Calx may not be wasted, which will remain at the bottom much finer than the Ordinary. Take then of this fine Calx, of Crystal Fritt made with Tarso, ground and forced fine, of each 50 pound, of white salt of Tartar eight ounces, powder, force and mix them well: Then put this stuff into a new earthen pot baked, giving it a fire for ten hours, then powder it and keep it in a dry covered place. Of this stuff are made all the Enamels of whatsoever colours. This shall be call'd the stuff for Enamels.

To avoid our Authors repetitions observe
1. The pots wherein Enamels are made must be glazed with white glass and bear the fire.
2. Mix and incorporate well the colours and stuff for Enamels.
3. When the Enamel is refined, and the colour good, and well incorporated, take it from the fire with a pair of tongues for the Goldsmiths use.
4. The way to make Enamels is this:

powder,
powder, grind, and fierce well the colours, and mix them first well one with another, and then with the stuff for Enamels, then set them in pots in the furnace, when they are all melted and incorporated cast them into water, and when dry set them in the furnace again to melt (which they soon do) make a proof, and if the colour be too high, take out some of it and add more of the stuff for Enamels, and if too light add more of the colour at pleasure to your content, then take it out of the furnace.

A Milk-white Enamel.

CHAP. XCIV.

Take of the stuff for Enamels six pound, of Manganese prepared 48 grains, cast it thrice into water when refined and melted.
An Enamel of a **Turcois** colour.

**CHAP. XCV.**

Take of the stuff for Enamels six pound, melt refine and cast it into water, set it in the furnace again; when 'tis melted, and refined, put in of thrice calcin'd Brass three ounces, Zaffer prepared 96 grains, wherewith mix well 48 grains of Manganese prepared, mix them well and put them into the stuff at four times, mixing them well every time, let them incorporate, make a proof with your eye that you may know by the eye when the colours are good, as I have always done, because sometimes the powders colour more and sometimes less. Thus I did at Pisa, and by mine eye without weights coloured all sorts of Glass.
Another Azure Enamel.

CHAP. XCVI.

Take of the stuff for Enamels four pound, wherewith mix of Zaffer prepared two ounces, and mix with it at first of thrice calcin'd Brass 48 grains, mix these two powders well with the stuff for Enamels, set them in the furnace, and work according to the rules.

A Green Enamel.

CHAP. XCVII.

Take of the stuff for Enamels four pound, put it in the furnace, and in ten or twelve hours 'twill be melted and refined, cast it into water, and put it again into the furnace in its own pot, when 'tis refined, give it of Brass thrice calcin'd two ounces, wherewith mix of scales of Iron well
well ground two ounces, put them in at three times, mixing and incorporating them every time, and ever and anon see whether the colour please, when 'tis well take it from the fire.

Another Green Enamel.

CHAP. XC VIII.

Take of the stuff for Enamels six pound, wherewith mix well Ferretto of Spain well ground three ounces, and mix with it 48 grains of Crocus Martis, put them into the furnace, &c. These furnaces are made from about four to six inches for all Enamels.

Another Green Enamel.

CHAP. XC IX.

Take of the stuff for Enamels four pound, which in few hours will be refined, then cast it into water, and put it again

L 4
The sixth Book.

again into the furnace, and let it refine, then add these two powders well mixed at three times, to wit, of Brass thrice calcin'd two ounces, of *Crocus Martis* made with Vineger 48 grains, put them in the furnace, and when they are well incorporated, take them from the fire: This is a fair and good Enamel.

---

**A Black Enamel.**

**C H A P. C.**

Take four pound of the stuff for Enamel, of *Zaffer* and *Manganese*, of each two ounces prepared, and well mixed, incorporate the stuff and colours, put them in the furnace in a large pot, and when refined cast them into water, then put them in the furnace again, and they will soon refine, and make a Velvet Black.
Another Black Enamel.

CHAP. CI.

Take of the stuff for Enamels six pound, of Zaffer prepared, of Crocus Martis made with Vineger, of Ferretto of Spain, of each two ounces, grind and mix well together these three powders, with the stuff for Enamels, put them into the furnace, and when refined cast them into water, put them in the furnace again, and take the Enamel out when 'tis incorporated, and the colour pleaseth you. This is a fair Black.

Another Black Enamel.

CHAP. CII.

Take of the stuff for Enamels four pound, Tartar four ounces, Manganese prepared two ounces, grind and mix these two powders well with the stuff for Enamels,
mels, set them in the furnace in a large pot, when melted and refined, cast them into water, and put them into the furnace again, let them refine. This is a most fair Velvet Black to Enamel upon metalls ordinarily.

A Red Enamel.

CHAP. CIII.

To four pound of the stuff for Enamels, add two ounces of Manganese prepared, mix them well, and let them in the furnace in a large pot, when tis refined and melted cast them into water, let them again in the furnace, and when refined take them out. This is a fair Purplish Enamel.
A Purplish Enamel.

CHAP. CIV.

Take of the stuff for Enamels six pound, of Manganese prepared three ounces, of Brass thrice calcin'd six ounces, mix them all well together, set them in a furnace, and let them refine, then cast them into water, and put them into the same pot, let them boil, and when refined take them from the fire. 'Tis a good Enamel.

A Yellow Enamel.

CHAP. CV.

Take of the stuff for Enamels 6 pound, of Tartar three ounces, of Manganese prepared 72 grains, grind and mix well these powders together, and then with the stuff for Enamels, put them into the furnace in a large pot, when refined cast them into
The sixth Book.

into water, and set them again in the furnace. This Enamel is of a fair Yellow to Enamel on Gold, where it shews not well, if you add not Enamels of other colours.

A Sky coloured Enamel.

CHAP. CVI.

Take of the stuff for Enamels 4 pound, Brass calcin'd to make a Sky colour, as in Chap. 21. of Sea-green made as in Chap. 23. of each two ounces, of Zaffer prepared 48 grains, mix first these powders well together, then with the stuff for Enamels, when they are refined cast them into water, return them into the pot, let them melt and refine. This is a very fair and beautiful Sky colour.
A Violet colour'd Enamel.

CHAP. CVII.

Take six pound of the stuff for Enamels, of Manganese prepared three ounces, of thrice calcin'd Brass 48 grains, mix these two powders well together, then remix them with the stuff for Enamels, put them into the furnace, and cast them into water, put them into the furnace again, and do as before.
CHAPTER I

After he found no hope of life or happiness of ignorance, he began to fear the greatness of the world, and to be sensible of the weakness of his own understanding. Thus he began to take a method to improve his mind, and to prepare it for the use of knowledge and virtue, and to engage his thoughts in the serious study of the scriptures, and to go on as before mentioned.
The seventh Book. Wherein is shown the manner how to extract Yellow Lake for Painters, from Broom flowers, and all other colours, with another way to extract Red Lake, Green, Azure, Purple, and all colours from all kindes of Herbs and Flowers.

And to make Cochin, Ultramarine, and Lake, from Cochneel, Brasill, and Madder for Painters, and also to colour discoloured Turcoises; another way to make a transparent Red, and a fair Red to Enamel upon Gold and Metalls, things neither Vulgar nor common.

In this Book is shown the way to extract all colours from Flowers and Herbs,
Herbs, for the use of Painters, which may serve also for glass; and Lakes of many colours; and ultramarine from Lapis Lazuli, all which things though in particular useful for Painters, may notwithstanding serve to colour glass in the superficies, and also in the fire of the furnaces, such is the ultramarine, and also the way to make a transparent Red in glass, which seems at this day to be wholly lost, as a thing not profitable, and to make a fair Red, to Enamel upon gold all materials in the Art of glass, and at this day much conceal'd, and known to few, and many other things which I judged meet to be put in this present work, which I believe will be acceptable to curious and ingenious Spirits.

A Yellow Lake to Paint, from Broom Flowers.

CHAP. CVIII.

Make a Lee of Barillia, and of Lime; reasonable strong; and in this Lee, boil
boil at a gentle fire fresh Broom Flowers, that the Lee may draw to it all the tincture of the Flowers, which you shall know by taking the Flowers out and seeing them white, & the colour well taken out, and the Lee will be yellow like good Trebian wine: then take out these Flowers, and put this Lee in earthen dishes (glased) to the fire, that the Lee may boil, and put into it, so much Roch-Alum, that with the fire, all the Alum may be dissolved; then make a fire, and empty this Lee into a vessel of clean water, and it will give a Yellow colour at the bottom: let them settle, and decant off all the water, and again put upon them other fresh water, and decant it off; let the tincture first sink to the bottom, and do this so long, till you have taken out all the salts of the Lee and Alum from the tincture; observing that by how much the more you wash this tincture from the salt of the Lee and Alum, by so much more will the tincture of the colour be fairer, and more beautiful, washing it always with water to carry away the salt of the Lee and Alum, and at each time before you decant the water, let the Yellow tincture settle to the bottom.
bottom. Repeat this process, until you perceive the water run out sweet and without saltiness as 'twas first put in, and then at the bottom will remain a beautiful and fair Lake: which spread, when wet, upon pieces of white cloth, and dry it upon new baked Bricks in the shade, and you shall have a beautiful Lake of a Yellow colour, for Painters, and also for glass.

---

To extract Lake from wilde Poppies, Flower-deluces, Red Roses, Red Violets, and from all sorts of Green Herbs.

CHAP. CIX.

Get what quantity of the leaves of Flowers of what colour soever they be, let every colour be by itself, fair Green Herbs by themselves: proceed with them as in Chap. 108, and you shall have a Lake & true tincture & colour from every Flower, and Herb, which will be a fair, and beautiful thing for Painters, and without doubt, worthy to be much esteem'd.
To extract a Lake, and colour to Paint, from Orange Flowers, Red Poppies, Flower-deluces, ordinary Violets, Carnation and Red Roses, Borage and Cabage Flowers, Gilli-Flow-ers, from all Flowers whatsoever, and green from Mallows, Pimpe-
nells, and all other Herbs.

CHAP. CX.

Take of whatsoever Herb, or Flower, of whatsoever colour you will, which being bruised green upon a leaf of white Paper, tinges it with its colour, these are good, but the Herbs and Flowers which do not so, are not good, then put into a glass body ordinary Aqua vitæ, the head must be as large as possible, and in the top thereof put the leaves of whatsoever Flower or Herbs, from which you would draw a tincture, then lute the joynts of the head, and thereto fit a receiver, then give
The seventh Book.

give a temperate heat, that the thinner parts of the Aqua vitæ ascending to the head, and falling upon the leaves and Flowers, may suck out the tincture, and distil thence into the receiver coloured Red, and full of the tincture of the Flowers, making all the subtile part of the Aqua vitæ to ascend so long as it comes coloured, and then distill this Aqua vitæ coloured in a glass vessel, which will come over white, and may serve at other times, and the tincture will remain at the bottom, which must not be dried too much but moderately, and thus you shall have the tincture or Lake from all Flowers, and Herbs, singular for Painters.

A Blew to make.

CHAP. CXI.

Take Quick-silver two parts, flour of Brimstone three parts, sal Armoniack eight parts, grind them all upon a Porphyry, and with the Quick-silver, put them in a glass with a long neck luted at the bottom.
tom in sand, make a gentle fire till the moisture rise, then stop the mouth of the glass, and increase and continue the fire, as in sublimation, till the end, and you shall have a Blew, most fair and excellent.

How to colour natural Turcoises discoulored.

CHAP. CXII.

Put Turcoises discoulored, and become white, into a glass, pour upon them oil of sweet Almonds, keep this glass upon temperate ashes, and warm, and in two days at most the stones will have acquired a most beautiful colour.
A mixture to make spheres.

CHAP. CXIII.

Take of Tin well purified and purged, three pound, Copper well purified one pound, melt these two mettals, first the Brass, then the Tin, and when they are well melted cast upon them six ounces of Tartar of Red wine only burnt, and one ounce and a half of Salt-peter, then a quarter of an ounce of Alum, and two ounces of Arsnick, let them evaporate, then cast it into the form of a sphere, and you shall have a good material, the which you shall cause to be burnished and polish'd, which will shew well, and this is the mixture called steel to make spheres.
The manner how to colour within Balls of glass, or other vessels of White glass, with all sorts of colours, which will imitate natural stones.

**CHAP. CXIV.**

Take a Ball, or other sort of glass that is white & fair, & Isinglass which must be infused two days in common water, then put this infusion into a white pan with fair water, and boil it till all be well tempered, observing that the Isinglass will be very tender with much water, then take it from the fire, and when it is warm, put it into a Ball of glass, & turn the glass round, that the Isinglass may fasten and wet every where the glass within, this being done let the moisture drain and run out, then have in order these colours powdered, to wit Red-lead; and casting it into the glass it will make the said colour stick (which will run in waves) cast it into many places through a tube, then throw in blew smalts making it.
it stick in waves, within the Ball. Then do the same with Verdigreas, then with Orpiment, next with Lake, all well ground, always casting the colours in many places in waves, which by means of the Isinglass which hath moistned the glass within, those powders will every where stick to the glass; and so shall you do with all colours. Then take Gesso well powdered, and put enough thereof into the Ball, and suddenly turn it about, that it may stick every where to the glass within. Do this work nimbly whilst the moisture of the Isinglass glass lasteth, that the powder may stick well, then empty by the hole of the glass the Gesso which is within the Ball, which shall then appear of divers colours with a most fair appearance like the natural Toies of hard stones, and at last these colours (when the Isinglass is well dryed) stick so that afterwards they will not fall off, and always their colour is most fair without. Fit to these Balls a foot of wood, or of other stuff painted, and they are held for beauty before Cabinets, and for Merchants counting houses very fair.
Ultra-marine.

CHAP. CXV.

Take fragments of Lapis Lazuli, found plentiful at Venice at a low price, let these fragments be well coloured with a fair Skie colour, lay aside those that are not coloured, calcine them well in a Chrysible, and so heated, cast them into cold water, repeat this twice, then grind them upon a Porphyrie, to an impalpable powder as fine as wheaten flour sifted.

Take then three ounces of the Rosin of the Pine, Black Pitch, Mastick, new Wax, Turpentine, of each three ounces, Linseed Oyl, Frankincense, of each an ounce, dissolve them in a new earthen Pipkin at a gentle heat, stir and incorporate them with a Spatula, then cast them into cold water, that they may cleave in a lump for your need.

Take for every pound of Lapis Lazuli ground as before, ten ounces of the aforesaid past of gums, which dissolve in a Pipkin
Pipkin at a gentle fire, and when it is well dissolved, cast in by little and little, the said powder of Lapis Lazuli, and incorporate it with the gum with a Spatula, I cast all the materials thus hot being incorporated suddenly into cold water, and bathing my hands with Linseed Oyl, made a round pastill hereof long and proportionally thick. Of these pastils you may make one or more according to the quantities of the materials, keep these pastils fifteen days in a great vessel full of cold water, changing the water every two days, then shall you boil in a Kettle common clean water, the pastils in clean and well glazed earthen pans, and cast upon them warm water, and so leave them till the water is cold, the said water being emptied out, cast upon them new warm water, and when it is cold empty it out, putting in again warm water, and when it is cold, empty it out, putting in again warm water, repeat this so many times till the pastils be dissolved by the warmth of the water, then put in new warm water, and you shall see the water will be coloured of a Sky colour, decant the water into a pan well glazed and cleaned. This casting on of warm water upon the
The pastils, must be repeated till it be no more coloured, but observe that the water be not over hot, but luke warm only, for too much heat makes the Ultramarine grow black. All these coloured waters strained into pans, have in them the unctuosity of the gums, therefore they must be left to settle 24 hours, that all the colour may sink to the bottom, then the water with it's unctuosity must be leasurely decanted off, put upon the pastils clear water, and then strain the cold water thorow a fine strainer, stirring the colour that it also may pass the strainer, and by this means a great part of the foulness and unctuosity will remain in the strainer, wash the strainer always with fair water. And with new water pass the Ultramarine thrice thorow the serce, washed every time, and then usually all it's filthiness will remain in the strainer. Put the Ultramarine into clean pans, decant the water softly off, which dry of it's self, and you shall have a most beauti-ful Ultramarine, as I have often made it at Antwerp. The quantity from a pound of Lapis Lazuli shall be more or less according as the stone is of a fuller and fairer colour. Then grind it to an impalpable pow-der
der on a Porphyrie (as is abovesaid) and 'twill arise most beautiful. If you take common Blew smalts ground on a Porphyrie to an impalpable powder, and incorporate it with the gumm pastils with the foresaid quantities, keeping them indigestion in cold water 15 days with Lapis Lazuli, and work thorowout as in Lapis Lazuli, you shall have a very fair and sightly Blew Bice, which will seem to be an ultramarine. These Blews not onely serve for Painters, but to colour glas excellently.

A Lake from Cochineel for Painters.

CHAP. CXVI.

Infuse one pound of the shearings of the finest Woollen Cloath in cold water a day, then press them well to take away the unctuosity the Wooll hath from the Skin, then Alum these shearings after this manner.

Take four ounces of Roch-alum, two ounces
ounces of crude Tartar powdered, put them into a small pipkin with about three flagons of water, when it begins to boil put in the Flox, and let them boil half an hour at a gentle fire, then take them off to cool for six hours, after take out the Flox and wash them with fair water, let them stand two hours, then press the water well from them, and let them dry.

---

A Magistry to extract the colour from Cochineel.

**CHAP. CXVII.**

Cold water four gallons, wheaten bran four pound, Saline of the Levant, Fenugreek, of each a quarter of an ounce, put them into a pipkin over the fire till the water become so hot one may hold his hand in it, take them from the fire, cover the pipkin with a cloath, for twenty four hours, to preserve well the colour, then decant the Magistry for use.

Put into a clean pipkin three gallons of cold
cold water, and one of the said Magistry, when it boils, of Cochineel powdered, after this manner, in a Brass Mortar, powder and serve one ounce of Cochineel, so many times, till all pafs the serve, at last take a little crude Tartar, pound it in the mortar, and 'twill take up all the tincture sticking to the bottom of the Mortar, and to the Pestle, mix this Tartar with the Cochineel served, and as soon as the water in the pipkin boils put in the Cochineel, and let it colour the water whil'st you can say a Misereere.

Then take the Flox Alumed as before, which must first stand in a pan of cold water for half an hour, and when the water is well coloured, press well the water from the Flox, put it into a pipkin, and stir it about very often, with a little stick, that the Flox may be well tinged, let it stand half an hour over the fire that it may boil gently, then take the pipkin from the fire, and take out the Flox, mixing it with a clean stick, put it into pans full of cold water, and in half an hour let all the water drain off, and put more cold water, let that drain, and press it well, and let it to dry in a place where no dust falls, spread it a-
The seventh Book.

broad that it may not become musty, and heat again. Take heed that the fire be always very gentle, for with two strong a fire the colour becomes Black. Then shall you make a Lee in this manner, to wit,

Take ashes of Vine branches, or of Willows, or of other soft wood, put them upon doubled Canvas, and pour gently on them cold water, let the water run into a pan, pour twice this strained liquor upon the ashes, and let the Lee settle 24 hours, that the ashes may sink to the bottom, and when 'tis pure and clear, decant it off into other pans, putting by the terrestriety which is not good.

Put the said coloured Flox, into a clean and cold pipkin, with the Lee, boil them at a most gentle fire, for so the Lee will be tinged with a Red colour, and will draw the tincture from the Flox, and at first take a little Flox and press it well, and if the colour be discharged, take the pipkin from the fire, and this is a sign that the Lee hath drawn the tincture of the Cochineel from the Flox.

Hang an Hypocras bag of Linnen, over a great and capacious pan, strain thorow this bag all the tincture from the pipkin, and
and let the Flox also go into the bag, when the Lee is dryned, press the bag where the Flox are, that you may have all the tincture. Then wash the bag from the hairs of the Flox, turning them inside outwards, that they may come forth pure and clean.

Then take 12 ounces of Roch-alum powdered, put it into a great glass of cold water, let them stand till all the Alum is dissolved, then fitly place the said bag well washed from the hairs of the Flox betwixt two sticks in the air. The bag must be large at the mouth, and narrow at the bottom, sowed in the manner of a round pyramid, and under the bag set a clean pan, then cast all the Alum water into the pan where the tincture of Cochineel is, and you shall see the Alum water suddenly separate the tincture from the Cochineel like as a Coagulum doth. Then with a clean dish cast into the bag all the said tincture and Lee, which will run clear out of the bag, but the tincture will stick to the bag. And when all the water is well near out, if happily any strain through somewhat coloured, pour it again into the bag, and then this second time 'twill leave all the tincture
The seventh Book.

cture in the bag, and the Lee will then run white and discharged of tincture. Then take clean sticks, and therewith mix the tincture which sticks on the bag in gross pieces, and have in readiness new baked bricks, whereon spread little pieces of linen, and on the linen small pieces of Lake which you shall take out of the bag, let them dry well, spread them not too thick that they may soon dry, for when the Lake stands long wet it grows musty and makes a foul colour. Wherefore you may, when the brick hath sucked out much moisture take another new brick, and so you shall soon dry it. When 'tis dry take it from the linen, and this is a good Lake for painters, which I have oftentimes made at Pisa. Observe, that if the colour be too deep, you must give it more Rock-alum, but if too light less Roch-alum, for so the colours are made according to you gust and will.
The seventh Book.

Lake of Brasil and Madder very fair.

CHAP. CXVIII.

If you would make a Lake of these materials each of them by themselves, you shall do in every thing as is before said of Cochineel, colouring the water with one of these materials, but you shall not use so much Alum by an ounce as you did in Cochineel, for Cochineel hath it's tincture deeper than Brasil, & Madder have. Wherefore you shall give them their proportion, which you shall find by practice. And also to one pound of Flox you shall use more Brasil or Madder, for they have not so great a tincture weight to weight as Cochineel hath. And in this manner you shall have a very fair Lake for Painters, and with less charge than that from Cochineel, and that from Madder in particular will arise most fair and very sightly.
Lake from Cochineel after another and more easie manner.

CHAP. CXIX.

In this way invented by me at Pisa, you meet not with Flox nor Magisterie, nor Lee, nor dying the Wooll, nor so many things as go the former, which indeed is a very laborious way, though most true. But this way is most easie, and worketh the same effect, and 'tis this which followeth.

In a pottle of Aquavitæ of the first running, put one pound of Roch Alum well powdered, when it is all dissolved, put in an ounce of Cochineel powdered and sifted in every thing as before, put all this in a glass body with a long neck, and shake it well, and the Aquavitæ will be wonderfully coloured, let them stand four days, then empty this stuff into a clean earthen glazed pan, then dissolve four ounces of Roch-alum in common water, cast this into the pan of Aquavitæ coloured with Cochi-
Cochineel, and put this into the Hyppocras bag, and so proceed throughout as in the 117 Chap. This is a most noble Lake from Cochineel, made with small pains, and in much greater quantity. All this was tryed at Pisa.

A transparent Red in Glass.

CHAP. CXX.

Take Manganese ground to an impalpable powder, mix it with as much more refined Salt-peter, set it to the fire in an earthen pan to reverberate and calcine 24 hours, then take and wash it with common warm water from its saltiness, the salt being separated, dry it, and it will be of a Red colour, hereto add its weight of sal Armoniack, and grind them together on a Porphyrie, wet them with distill'd vinegar, let them dry, then put them in a Retort which hath a large body, and a long neck, give them a subliming fire in sand for 12 hours, then break the glass, and take all that is sublim'd to the neck, and body of the
the Retort, & mix it with the bottom & remaining residence, weigh them and add as much sal Armoniack as shall be wanting in this first sublimation, grind them all together on a Porphyrie, imbibing them with distilled Vinegar, then sublime them in a retort as before, and this sublimation is to be repeated after the same manner so long till the Manganese remain all at the bottom fusible.

This is the medicine that colours Crystal and past into a Red Diaphanous colour, and into a Rubie colour, there are used of this medicine 20 ounces, to one of Crystall or glass, but more or less may be used thereof according as the colour requires. The Manganese must be of the best from Piemont, to colour glass of a fair, and very sightly colour.
The seventh Book.

A Red as red as Blood.

CHAP. CXXI.

Put six pound of glass of Lead, common glass ten pound, into a pot glazed with white glass, when the glass is boiled and refined, give it Copper calcined to redness according to discretion, let them incorporate, mixing well the glass, then give it so much Tartar powdered that the glass may become as Red as blood, if it be not so much coloured, add Copper calcin'd to Redness, and Tartar, till it come to this colour.
Put Crystall Fritt in a pot into a furnace, cast it thrice into water, then tinge it with Manganese prepared into a clean purple, then take Alumen Catinum sifted fine, put in thereof so much as will make the glass become purple, and this you shall do eight times, and know that Alum makes the glass grow Yellow, and a little reddish, but not blakish, and it always makes the Manganese fly away; and the last time that you add Manganese, give not the glass more Alum except the colour be too full, and so you shall have a most fair Balass colour.
To extract the *Anima Saturni* which serves for many things in Enamels and glass.

**CHAP. CXXIII.**

Put Litharge well ground into an earthen pan well glazed, pour upon it distilled Vinegar, which must be higher than it four fingers, let them stand till the Vinegar is coloured into a milkie colour, which it will suddenly be, decant off this coloured Vinegar, and put new upon the Litharge, repeat this work till the Vinegar becomes no more coloured. Then let these coloured Vinegars stand in earthen pans glazed that the milkie substance of the Lead may sink to the bottom, decanting off the clear Vinegar, this milkie material is the *Anima Saturni*, to wit the most noble part, which serves for enamells, and glass in many things, and if this white stuff precipitate not well, cast upon it cold water, which is wont to make it fall to the bot-
The seventh Book.

The seventh Book.

185

tom, and when it doth not precipitate evaporate the Vinegars and waters, and the more subtile part remains at the bottom good for many things in this Art.

A fair Red to Enamel Gold.

CHAP. CXXIV.

T Ake Crystall Fritt made in this manner, to wit, salt of Polverine ten pound, white Tarso finely ground eight pound, make a solid past with this stuff, and water, and make thereof as it were small and thin wafers. Put these on earthen pans in a little furnace made in the fashion of a calcar, that they may be calcin'd with a good fire ten hours, and in defect thereof put them in the furnace, near the Occhio, for three or four days till they be well calcin'd. Take calcined Lead, and Tin prepared as in Chap. 93. Tartar of white wine calcin'd, of each two pound, mix them well together, and put them into a pot glazed with white glass, let them melt, and refine well, then cast them into water,
do this twice, then put them in the furnace, and when well refine'd in the pot give them of Copper calcin'd to Redness ten ounces. Let the colour purifie well, then give it Crocus Martis made with Aqua-fortis, putting it in by little and little, as you do with Manganese, then let it settle six hours, and see whether the colour be good, if not give it Crocus by little and little, till you have the desired colour.

A fair Red for Gold after another Manner.

C H A P. CXXV.

Take Crystall Fritt, made as in Chap. 124. four pound, melt it in a clean pot glazed, cast it, when refined, into water, and refine it again in the furnace, cast it into water a second time, and refine it again, then put in by little and little of calcin'd Lead and Tin purified, half an ounce at a time, let the Calces incorporate, and when the glass becomes of an ash colour, put in no more Calces. For too much of them makes
makes the colour white and not good. Let the glass refine with the calces, then put into the glass fine Red Lead two ounces, and when incorporated and refin'd well, cast them into the water, and set them in the furnace eight hours, then take of the Copper calcin'd to Redness, and of white crude Tartar of each half an ounce, put them and mix them well in the pot, then add of Lapis Hæmatites, wherewith the Cutlers burnish, and of fixed Sulphur, of each one Drachm, mix and incorporate these powders; and see if the colour be too deep, give it a little Manganese, which makes it lighter, and if it be too light a colour give it fixed Sulphur, and Lapis Hæ- matites, and a little of Copper calcin'd to Redness, and a little Tartar of white wine with discretion, and do this till it come to the desired colour.
To fix Sulphur for the work above-said.

CHAP. CXXVI.

Oil Flowers of Brimstone in common oil an hour, take them from the fire, and cast upon them the strongest Vinegar, and the Sulphur will suddenly sink to the bottom, and the oil will swim upon the Vinegar, empty the oil and Vinegar, and put new oil upon the Sulphur, repeat this thrice, and then you shall have a fixed Sulphur, for the work above-said.
Glass as Red as blood which may serve for the above said fair Red.

CHAP. CXXVII.

Melt in a pot of glass of Lead six pound, Crystall Fritt ten pound, cast them when refined into water, put them again into the pot, when they are well refined give this glass four or six ounces of Copper calcin’d to Redness, let them boil, and refine well, then give them Red Tartar powdered, which incorporate with the glass, let them refine, and see if the colour please you, and if it be not heightned with the Copper, and Tartar, put it again to anneal till it come to be sufficiently Red, this is done to heighten the colour.
An approved way to make a fair Red Enamel for Gold.

CHAP. CXXVIII.

Take of Crystall Fritt, boil it as in Chap. 124. six pound, refine it well in a glazed pot, and give it fine Calx of Lead and Tin prepared, as in Chap. 113. four ounces at four times, when well refin'd and incorporated cast them into water, and then melt and refine them well again in the furnace, and give this glass at three times one ounce and a half of Copper calcin'd to redness, which makes the deep Red, mixing the glass well, and let this powder incorporate, and refine well in the glass, and within two hours give it Crocus Martis made as in Chap. 16. one ounce & a half at three times, let it mix and incorporate well in the glass three hours, then add six ounces of Tartar burn'd, with one ounce of the soot of the Chimny well vitrified, and with these powders mix half an ounce of the said Crocus Martis, put these powders
ders well ground into the glasses at four times, mixing them well, and interpose a little space between each time, for they make the glasses swell and boil exceedingly, when all the powder is put in, let the glass refine three hours, then remix them, and take a proof, to wit, a little Bowl of glass, and scall’d it well, if it take a transparent Red, as blood, it’s well, if not, give it new Tartar burnt with Soot, and Crocus Martius, by little and little, till it come to the desired colour, let the glass stand to settle, and an hour after you put in the powder, take another proof as before. This is good to Enamel, and proved often times at Pisa.
Calcine Gold with Aqua-regis, many times, pouring the water upon it five or six times, then put this powder of Gold in earthen pans to calcine in the furnace till it become a red powder, which will be in many days, then this powder added in sufficient quantity, and by little and little, to fine Crystall glass which hath been often cast into water, will make the transparent red of a Rubie as by experience is found.
The way to fix Sulphur for a Rose-red to Enamel on Gold.

CHAP. CXXX.

Make a strong Lee of Lime, and Oaken ashes, boil sufficiently Sulphur in this Lee, which takes away a certain unctuous and combustible colour which Sulphur hath in it; by changing the Lee the Sulphur becomes white and incombustible and fixed, good to make this Rose-red for the Gold-smiths to Enamel upon Gold.
Vitriolum Veneris which was begun at the end of 31 Chap.

CHAP. CXXXI.

Set Chryfibles luted and covered in an open wind furnace with burning coals over them, let them stand two hours, and then at last let the furnace cool of itself, then take out the Chryfibles, and you shall find the Copper calcin'd to a blackish colour, having an obscure purple, which powder, and force well, then take a round vessel of baked earth plain at the bottom, which will bear the fire, set these pans in an open wind furnace, on iron bars set across, fill the pans with kindled coals, and put in the aforesaid calcin'd Brails, wherewith you have first mixed to every pound weight there of six ounces of common Brimstone powdered, & when the fire begins to heat the pans, and the Brimstone to flame and burn, continually stir the Copper with a long Iron having a hook at the top, that it may not stick, nor cleave to the pans; continue this
The seventh Book.

this till all the Sulphur be burnt and smoak no more, then take the pans from the fire thus hot, and all the Copper, with an Iron ladle or like thing, powder it well in a Brass morter, and serce it, which will then be a black powder, proceed thrice with the same quantity of Copper and Brimstone in every thing as before. Observe, that at the third calcination you let the pans stand over the fire, so long that the Copper acquires a red Lion colour, then take it from the fire, and powder it in a Brass mortar, and you shall have the said colour to make the said Vitriol as we are about to say.
Vitriolum Veneris without Corrosives, from which is extracted the true and lively Blew, a thing marvellous.

CHAP. CXXXII.

To make then the Vitriolum Veneris above said, take one or more very capacious Glass bodies, according to the quantity of the Copper calcin’d, and prepared, to wit, to a pound of Copper take a body which will hold six pints of water, put this common clean water into the body with calcin’d Copper into a sand furnace, give them a temperate fire for four hours, until of the six pints of water, there be evaporated about two, which is seen by the eye; let the furnace cool, and gently decant off the water into earthen pans glased, and the Copper which remains at the bottom put into pans in a furnace to evaporate all the moisture, and the water which is decanted into the pans will be coloured with

The seventh Book.
with a full and wonderous fair blew, let them stand thus in the pans two days to settle, and part of the Copper will sink to the bottom in a red substance, then filter the said water with usual linguets into glass vessels, and evaporate from the said Copper all the moisture, and with six ounces of Sulphur calcined, powder and force it to a black powder, as in Chap. 131, and then as in the beginning of this pour in water and extract the Blew colour. Consider that in this work many pots will be broken, wherefore as often as the pots are broken or cleft take a new one, lest they break in the furnace, and all your labour be lost; when the humidity is evaporated put the same quantity of Sulphur powdered and forced, and do as before. The reason why the Copper is to be taken out whilst it is hot, is, because then it is better separated from the pots, & it is impossible to separate it, if you suffer it to be cold, although you break the pots. Repeat this process not only four but five or six times in every thing as before, then the Copper will remain as a soft earth, and the better and most noble tincture of it will be in the filtered waters, all which mixed
together must be Filtered with the usual linquets, and the settling and dregs may be cast away as unprofitable, then you shall have a most limpid water, and coloured with a most marvellous blew colour.

The way to extract Vitriol from the said colour’d waters.

CHAP. CXXXIII.

Set then a great glass body that will hold three Flasques of liquour in ashes or sand in the furnace, and with a temperate fire evaporate the said colour’d waters, and neer to the furnace keep other glass bodies full of these colour’d waters, that they may be warm, and now and then fill the great body, which is in the sand with glass ladles, do this that the colour’d waters may be put in warm, for being put in cold they will make the great glass body break; evaporate the colour’d liquour from ten Flasques to two and a half or three, then these waters will be deep and full of tinture, which put into earthen
earthen glazed pans in a cold and moist place for a night, and you shall finde the Vitriol shot into points like Crystals, which will appear like true Orientall Emeralds, decant oft all the water that is in the pans, dry the Vitriol, and let it not stick to them, then evaporate half this water, which will yield you new Vitriol as before, Repeat this till you have gotten all the Vitriol. Put this Vitriol in a Retort well luted with a strong lute, see you put no more than one pound of Vitriol in a Retort, which must not be very large, and have a large and capacious receiver; make for 4 hours together a most temperate fire, for if it be too strong the moist and windy Spirits which first arise from this Vitriol, are so powerful, and arise with so great force, that no receiver is able to hold them; let the joynts also be very well luted. At last make a strong fire when the dry Spirits begin to rise in a white form, continue the fire till the Receiver begins to wax clear, and to be quite cold, then make no more fire, and in twenty four hours let the joynts be unluted, and the liquor which is in the Receiver must be kept in glass very well sealed. This is the true lively Azure, with which
which marvellous things are done, as you may well perceive by its smell, which is as powerful and sharp as any this day known in nature. Many things might be said, which are passed over as being not pertinent to the Art of glass, which happily you may judge upon better occasion; the feces then which remain at the bottom of the Retort will be black, which left some days in the air of themselves will take a pale blew, powder and mix this with Zaffer, and put it to Crystall metall as before, and with the said quantity will be made a marvellous Sea-green. Wherefore I have here set down the way to make this powder with much clearness, presupposing that I have not published an ordinary way to make it, but a true treasure of nature, and that to the content of noble and curious Spirits.
AN INDEX.

L


Glass of Lead 63. Saccharum Saturni 123.

Salt from Polverine Rochetta and Barillia 1. a better way 3. from Fern and other herbs 5, 6, 7.


Sphears 113.
AN INDEX.

Turcoises that have lost their colour 112.
Ultramarine 115.
Blew 111.

Colours to make.

Amethyst in glass 48.
Balsas in glass 122. In Crystall 74.
Black in glass 51, 52, 53. In Enamels 100, 101, 102.
Calcidony 42, 43, 44.
Chrysolite in Past 82.
Green in glass 33, 34, 35. In Enamels 97, 98, 99.
Girasole in Past 74.
Granat in glass 47, in glass of Lead 69.
in Past 87, 88, 89.
Lapis Lazuli in glass of Lead 72.
Marble colour in glass 56.
Opal in Past 74.
Peach in glass 57.
Paste, observations on them 90, 91, 92.
Pearl colour in glass 60.
Purple Enamel 104.
Red deep in glass 58. as blood 121, 127.
in Enamels 103.
AN INDEX.

Transparent in glass 120. Rose red in glass 120, 124, 125, 128.

Ruby in Past 74.

Sea-green in glass 22, 23, 26, 29, 30, 31, 131.

Saphyre in glass 49, 50. in glass of Lead 70. in Pasts 85, 86.

Sky colour in glass 23, in glass of Lead 68. in Pasts 83, 84.

In Enamels 106.

Topaz in glass of Lead 67. in Past 74, 81.

Turcois in glass 36. in Enamels 95, 96.

Viper colour in Crystall 73.

Violet Enamel 107.

White Enamel 94. white call'd Lattimo in Glass 54, 55.

Yellow in glass 46. in Enamels 105.

Observations on the Epistle to the Reader.

Concerning our Author, and this work, I find no other mention of him, than a bare naming him by Garso in his Book della dottrina universale, and by Bertius de sufficientia, Pag. 141. Neither could I ever find by strict inquiry that the other piece promised in the Epistle Dedicatory, and the Preface, concerning Chymical matters, was ever published, neither have I read in any Spagyrical writers quotations drawn thence. Wherefore I may easily conclude, that it never came to light, and it is no wonder he found no encouragement by this Book, to put forth that, since this kind of learning most useful to mankind, was accounted sordid and below the speculation of men living in those times; who wholly busied their subtile wits, either in contemplations useless, or indeterminable, most of whose notions were bare λογομαχίας. But our most learned Bacon, a man
Observations on the man of a most sublime, and piercing intellect, in his incomparable Novum Organum, hath fully confuted & shewed the vanity & inefficacy of that other way, and hath more wisely substituted another more effectual and operative, for the more solid promotion of Arts and Sciences. This way of useful learning hath been more experimentally followed by some particular persons, but not universally throughout. But now tis like to make a considerable progress, being designed by that most noble and honourable company of the Kings Society at Gresham College; which by the indulgence of His Sacred Majesty, restored to his people, for the promotion of all virtuous undertakings, weekly convenes to this very end and purpose, and daily bring in materials for this fair Edifice.

One part of this design this present Book contains, wherein is set forth truly and plainly, the whole business of making and colouring glass, which from his youth our Author had learned of able and diligent persons, or what experience, or the fire had taught him, and in many he tells you the time and places of his trial and invention, with all the circumstances thereof belonging.

Art of Glass. Our English word Glass is the same with the Dutch, and is deriv'd from
from the Latine, Glastum, which by removing the last syllable, is plainly Glass; now it appears that Glastum was called Vitrum, by Cæsar in his Commentaries, lib. 5. Where he saith, omnes Britanni se vitro in- ficiunt, all the Britans colour themselves with Glass, & Mela, lib. 3. cap. 6. Britanni vi- tro corpora infecti, and Vitruvius, wooll died with Glass, for so the learned Turnebus re- stores these places, where ’twas anciently read Ultrum for Vitrum; but that Vitrum is Isatis, appears by these words of Vitruvius, they colour for want of Indico Chalk from Selinitia Vitro, with Glass, which the Greeks call Isatis, as also by a Treatise of Apuleius de herbis, not published, but is in the hands of Doctor Merrick Causabon, larger and more correct than those that are published, he thus, Herbam Isatis alii Aogigneme prophetæ Aposion Itali alutam alii herbam vit- trum, which is to be written, Isatis alii An- gionen Prophetæ Arosion Itali rutam alii herbam vitrum. Salmatius ever falsely puts Guastum for Glastum, because the Britans continually call it Guadum, The which call a Blew colour Glass. And Pliny, lib. 22. chap. 1. witnesseth the same in these words, simile plantagini Glastum in Gallia Vocatur quo Britan-
Observations on the

Britannorum conjuges nurusque totô corpore obliræ quibusdam in sacris nudæ incidunt. The British women cover their bodies with Glastum, & in some Festivals go naked. And Cambden in his Britannia, this is the herb we term Woad, and it gives a Blewish colour, which the Britains at this day call Glass. The reason why Glastum acquired this name Vitrum, or Glass, might be, because all glass hath Naturally (as this Author and experience teacheth) somewhat of blewishness in it. Vitrum comes from Visum as Aratrum and Rutrum come from Aratum & rutum, the last syllable being changed into trum, so Iscodurus, lib. 16. cap. 15. Quod visui perspicuitate transluceat, because it is transparent to the sight: for in other metalls, whatsoever is contained within is hid, but in Glass all liquors, and things within appear the same as without, hence it is that many transparent bodies are call'd Vitrea, as the humour of the eye, the Sea, Rivers, Waters by Physicains, Horace, Ovid, and Boeth, and Apuleius of a spring.

Glass is one of the fruits of the fire. which is most true, for it is a thing wholy of Art, not of Nature, and not to be produced without strong fires. I have heard a singular Artist,
Artists merrily to this purpose say, that their profession would be the last in the world: for when God should consume with fire the universe, that then all things therein would vitrifie and turn to glass. Which would be true upon supposition of a proportionable mixture of fit Salts, and Sand or Stone.

'Tis much like all sort of mineral or middle mineral. I find Authors differ much about referring Glass to its Species. Agricola, lib. 12. de Metallis, maketh it a concrete juyce, Vincent Bellusensis, lib. 11. calls it a stone, Fallopius reckons it amongst the Media mineralia, and the workmen, when it is in a state of fusion call it metall. But to me it seems neither of these, which this general Argument sufficiently evinceth, that all the forementioned are natural concretes, but Glass is a compound made by Art, a product of the fire, and never found in the bowels of the earth, as all the others are.

Wherefore as factitious words of Art are excluded out of the predicaments by the Logicians, so is Glass to be excluded out of the former Species. Neither is it more to be call'd a metall, concrete juyce, than Beer or Malt, Barley, or Lime, a Stone, or Brick, Earth, &c. But to this argument Fallop, thus replies, by ask-
Observations on the
asking of what Glass we speak, whether of that
which is in it's own Mine, and it's own stone,
or else of true Glass, and now extracted from
the stone? if of this purified, he saith 'tis
no more Artificial, than a metall is extracted
from it's Mineral, and purified. But if we
understand it of that which is the first stone,
then he saith that as metall in the Mine and
proper stone, so glass having it's existence in
the stone, whence 'tis educed, is natural. To
whom I answer, that Glass is never found in
that form in any Mine, but onely Sand, and
Stones which are the Materials of it. But of
Metalls 'tis far otherwise, which nature hath
perfectly formed into a certain Species in pro-
per veins, though sometimes they are by the fire
forced out of the veins, and Earth or stones
wherein they in smaller particles and Atoms
lay hid. And with this difference too, that fire
onely produceth or rather discovers Metalls
by it's innate energie of separating heterogene-
ous bodies and congregating homogeneus: But
in Glass 'tis far otherwise, for that is made by
uniting and mixing different parts of salt and
sand. which Fallopius to admiration denies,
saying, that 'tis false that Glass is made of
Ashes, and he adds, that although Glass-men
add ashes brought from Alexandria, or from
other
Epistle to the Reader.

other places, yet he saith that ashes is added instead of Nitre which the Antients used, that they might more easily extract Glass from the Metalline stone. Yet we may not say that ashes is mixed with the Metall to make Glass, but that 'tis onely put into the furnaces where Glass is melted, that Glass may be more easily educed from the smallest and inmost particles of the Glass-stone, that is, of it's proper Metall; so far be. But this strange opinion is easily confuted; for if Glass were extracted from the stones onely, then the weight of the Metall must needs be far less than the stones alone, but in truth the weight of the Metall far surpasseth that weight, for 100 weight of Sand yields above 150 of Metall; besides, the Salts composing Glass are the most fixed salts, which the fire cannot raise with the most vehement heat.

Again in old windows of French Glass, in that part which lies towards the air, you may manifestly discern, nay, pick out pieces of salt, easily discovering their nature to the taste; furthermore in the finest Glasses, wherein the salt is most purified, and in a greater proportion of salt to the sand, you shall find that such Glasses standing long in subterraneous and moist places will fall to pieces, the union of the salt and sand decaying. And this is the reason.
Observations on the

son of that saying, that Venice Glasses will
break with poison, which is true of some Mi-
neral, but not of Vegetable or animal poison.

All which manifestly evince that salt remains
in the Glass in specie. Add hereunto that ex-
periment of Helmont, Cap. de terra, who
thus saith, Si vitri pollinem pluri alkali
quis colliquaverit ac humido loco expo-
fuerit, reperiet mox totum vitrum resolvi
in aquam, cui si affundatur Chrysulea, ad-
dito quantum saturando alkali suffecerit,
veniet statim in fundo arenam sedere eo-
dem pondere quæ prius faciendo vitro
aptabatur. If you melt fine flour of Glass
with good store of Sandever, and set them in
a moist place, you shall soon find all the Glass
resolved into water, whereunto if you pour as
much Aqua-fortis, as will suffice to saturate
the Sandever, you shall find the sand present-
ly settle to the bottom in the same weight which
was put in at first.

And in this experiment the salt is imbi-
bed, and taken up by the Sandever, and Aqua
Regis, and so the component parts analysed into
their former principles, which were before con-
fused in the compound.

A second general argument is this, that
though the said concrete juices stones and
Glass,
Glass, may have fusion in the fire, yet neither all stones, nor all concrete juices, Metalls, nor Semimetalls have fusion, such are Talc and English Spaud, tal Armoniack, Tincal, &c. Reckoned amongst concrete juices; nor Diamonds, Cats-eyes, Agate, Jaspers, nor most other precious stones, nor Marble; Nor many other stones wherewith the inside of these furnaces are built. Neither can Mercuric amongst Metalls be said to melt, nor amongst the middle Minerals Orpiment; and though most of them have fusion, yet none of them have ductility, but Metalls onely, and they one-ly too, when they have received a great degree of cold; for when they are red hot the particles of them stick not together, nor are so Tenacious as Glass is, which onely whilst it is red hot, will with small force of the breath receive any fashion or figure, and by blowing form a cavity, none whereof any of the afore-said bodies will do; besides metall poured out, when melted, will run into many small globuli, or pieces, but glass sticks together in a lump even in the furnace itself, when the pots are broken. And this quality of ductility, and tenacity, I make to be the essential difference of glass from all other bodies; nay from all other substances, which have gotten the name
Observations on the
of glass, as Vitrum Antimonii, Moscovie
glass, and bricks or other stones vitrified, nei-
ther whereof will bear this tryal, which ra-
ther have their denomination from their tran-
sparency, (as Vitriolum too hath a Vitro) than from their intrinsecal nature and pro-
perties. But to shorten this comparison, I shall
here set down the proprieties of glass, whereby
any one may easily difference it from all other
bodies.

1 'Tis a concrete of salt and sand or
stones.
2 'Tis Artificial.
3 It melts in a strong fire.
4 When melted 'tis tenacious and sticks to-
gether.
5 It was not nor consumes in the fire.
6 'Tis the last effect of the fire.
7 'Tis ductile whilst red hot, and fashion-
able into any form, but not malleable, and may
be blown into a hollowness.
8 Breaks being thin without annealing.
9 'Tis friable when cold, which made our
proverb, As brittle as glass.
10 'Tis diaphanous either hot or cold.
Epistle to the Reader.

11 'Tis flexible and hath in threads motum restitutionis.

12 Cold and wet disunites and breaks it, especially if the liquors be saltish, and the glass suddenly heated.

13 It only receives sculpture, and cutting, from a Diamond or Emery stone.

14 'Tis both coloured and made Diaphanous as precious stones.

15 Aqua fortis, Aqua Regis, and Mercury, dissolve it not as they do Metalls.

15 Acid juyces nor any other thing extract either colour, tast, or any other quality from it.

16 It receives polishing.

17 It loseth nor weight, nor substance, with the longest and most frequent use.

18 Gives fusion to other Metalls and softens them.

19 Receives all variety of colours made of Metalls both externally and internally, and therefore more fit for Painting than any other thing.

20 'Tis the most plyable and fashionable thing in the world, and best retains the form given.

21 It may be melted but 'twill never be calcined.
Observations on the

22. An open glass fill'd with water in the Summer will gather drops of water on the outside, so far as the water reacheth, and a mans breath blown upon will manifestly moisten it.

23. Little balls as big as a Nut fill'd with Mercury, or water, or any liquor, and thrown into the fire, as also drops of green glass broken fly assunder with a very loud & most sharp noise.

24. Wine, Beer nor other liquors will make them musly, nor change their colour nor rust them.

25. It may be cemented as Stones and Metals.

26. A drinking Glass fill'd in part with water (Being rub'd on the brim with the finger witted.) yields Musical notes, higher or lower, according as 'tis more or less full, and makes the liquor frisk and leap.

Antiquity of Glass.

Concerning the Antiquity of Glass, our Author here fetcheth it from Job Chap. 28. v. 17. Who in this Chapter from v. 15. to the 20th compares wisdom to the choicest things; and in this 17th v. saith, Gold and Glass shall not be equalled to it. So our Author from the Vulgar Latine translation, the Septuagint, Hierom, Seres, Elias in no Menclatore. Hieron. Pineda, Biblia Tigurina, & Syriac, but Iacint in the Arabick translation.

Crystall, Chaldee, Santes, Arias Montanus,
Epistle to Reader.

A stone more precious than gold, as Pagninus from Rabbi Levi Kimhi.

A Looking glass, as the Thargum renders it; perhaps because in that time or age Looking-glasses were first invented and highly valued, being made of precious materials, and so Muncer reads it.

Glass of Crystal, Vitrum Crystallinum, Complutensis.

A Peril, as Vatablus.

A Diamond, Rabbi Abraham, Rabbi Mardocai, Pagnin, Cajetan, the Italian, Spanish, French, High and Low Dutch.

A Pyropus or Carbuncle, or some such neat and precious Gemm, as others, so Pineda: But both those are the same name of one stone, which the Ancients gave to such a gemm as would shine by night, but there's none such in nature, & the later writers take the Ruby for it.

The reason of this difference in the translators, is, because the Original word Zechuchih comes from the root Zacac which signifies to purifie, to cleanse, to shine, to be white, and transparent. The same word is applied to Frankincense, Exod. 30. 34, and is
Observations on the
is rendered by the Septuagint, Pellucid, Hence 'tis manifest why so many renderings of the text, since the word in general signifieth only what's transparent and beautiful, therefore the translators might apply the word to any thing which was of price and value, for so the text requires, and transparent too, for so the word requires. But it seems to be neither Diamond, Carbuncle, nor Iacinth, for those are mentioned in Aarons Breast-plate, Exod. 28. and this word here not to be found in that Chapter. Nor Glass nor Crystal, because 'twould seem incongruous, that those of so mean a value should be brought into comparison, the former being made of Materials very common, and the latter could not but be vulgar. Besides, 'tis probable this word subjoined to Gold, was added after it for amplification. Add hereunto, that Glass is no where mentioned in the Old Testament, though frequently in the New by S. Paul, S. James, and in the Revelation. And indeed who can imagine that a thing fit for so many illustrations, and comparisons, and of so common use, could be passed by in silence, if known, by the Scripture so full of elegancies in this kind? And therefore I judge it meet to keep the general word, and not to confine the sense to one pretious and tran-
transparent stone, or thing, but to extend it wider to all things that have those two properties in them. But too much of this in mete alienâ.

Aristophanes seems to be the first that mentions this word \(\varepsilon \alpha \lambda \zeta\), now rendered Glass; for in Nubibus, Act. 2. Scen. 1. he brings in Strepisades abusing Socrates, and teaching him a new way to pay old debts, viz., by placing a fair transparent stone told by the Druggists, and from which they strike fire, betwixt the Sun and the accusation brought in writing against him, for the Sun would soon melt away the letters of the accusation, which stone Socrates readily call'd \(\varepsilon \alpha \lambda \zeta\). Whereon the Scholiast thus, Druggists sold precious stones as well as Medicaments. And that the Antients call'd \(\chi \rho \iota \omicron \nu\), (the same with \(\chi \rho \iota \omicron \varepsilon \alpha \lambda \zeta\)) Crystall. That Homer knew not the name, and that with him and the Antients, the word Electrum was used, the Scholiast there testifieth, though he himself clearly describes our Glass in these words. We properly call that Glass which being melted by fire from a certain herb burnt to prepare certain vessels. Hesichius hath not the word \(\varepsilon \alpha \lambda \zeta\), in this sense, but Hyal-\(\nu\), Hyalon, Hyaloen, shining and Diapha-\(\nu\).
Observations on the nous. The Etymologist hath it in this sense and fetcheth the Etymon from τεύχω, to rain, from the likeness it hath to ice (which is congeled rain or water) in consistence and Diaphaneity, and in this sense, as some Glass from glacies ice. Aristotle hath two Problems of Glass, first, Why we see through it, Sect. 2. 61. secondly, Why it cannot be bended. Now if these Problems were Aristotel's (as learned men doubt whether they are or no) then this seems to be the most Antient piece of Antiquity for Glass. For neither in the Antient Greek Poets nor Orators shall you find any mention of Glass, though a thing so fit for their purpose, as was above said. And note the ambiguity of the word ιαλύς, for Crystal was so call'd as the Scholiast above, and Hugo Grotius, and these names are wont to be mixed by reason of the likeness of the things, and Gorræus faith, that, a certain kind of Yellow Amber, and transparent as Glass, was call'd by some Hyalus. The first then amongst the Greeks, that without question have mentioned Glass are Alex. Aphrod. who thus faith, As the Floridness of a colour is seen through Glass, and yet more clearly, lib. 1. Probl. Glasses in the winter in vehement and sudden heat coming upon them, break,
Epistle to the Reader.

and again, to break the Body of the Glass. And Lucian mentions very large drinking vessels of Glass. And Plutarch in his Symposiack, saith, that fire of Tamarisk wood is fittest to form Glass.

That the Egyptians were skilfull in this Art, appears by Flavius Vopiscus, quoted by Marcel. Donatus, in these words, Alexandria a City rich, fruitful, wherein nobody lives idle, some Blow glass, others make Paper, &c. Though Kicher in his Oedipus, writing of the Egyptian Arts, mentions not this.

Lucretius amongst the Latine Poets, is the first I find mention Glass, whose Verses I shall add, because they give his account of it's transparency.

--- nis recla foramina tranant Qualia sunt vitri, l. 4. 602, 603. and again, Atque aliuq per ligna, aliud transire per Aurum, Argentoq, foras, aliud vitreoq, meare. l. 6. v. 989, 990.

But downwards all the other Poets.

This Art was unknown to America, and all Asia, except Sidon, and China, who of late have learned to make it very perspicuous of Rice.
Observation on the Rice, but very brittle, and therefore not to be compared as yet with ours, though it come neer it. Atlas Cinicus, pag. 6.

But to decide this controversie, 'tis manifest that Glass could not be unknown to the Anti-ents, and must needs be as Antient as Potterie it self, or the Art of making Bricks, for scarcely can a Kill of Bricks be burnt, or a Batch of Pottery ware be made, but some of the Bricks, and ware will be at least superfi-

But to decide this controversie, 'tis manifest that Glass could not be unknown to the Anti-
ents, and must needs be as Antient as Pottery it self, or the Art of making Bricks, for scarcely can a Kill of Bricks be burnt, or a Batch of Pottery ware be made, but some of the Bricks, and ware will be at least superfi-
cially turn'd to Glass. And therefore without doubt 'twas known at the building of the Tower of Babel, and as long before as that Art was used, and likewise by the Egyptians: for when the children of Israel were in captivity, we read that making of Bricks was a great part of their bondage. And of this na-
ture must that Fossil Glass be, whereof Ferant Imperatus, lib. 25. cap. 7. thus saith, Glass like to the Artificial is found under the earth in places where great fires have been, neither whereof struck yield sparks of fire. Other Glasses are found in round clots like fire-
stones, shining in the breaking, and transparent with greeness, which in shew resemble Colo-
phonia, and these struck sparkle like fire-
stones. From which notwithstanding they are different
different as well in their Vegetation proper to fire-stones, as also in shining, and much quicker melting, proper to Glass. Of these said Glasses some are brittle, others solid, the brittle or crumbling, put in the fire, swell, and take the shape of white pumice-stone, and afterwards the shining of Artificial Glass: But those which are continued and solid, by a small change from the fire, pass from blackness to white Artificial Glass. This Fossil Glass is wrought by the Americans to make holes, and cut instead of Iron. So far he. And happily of this sort of Glass, was a piece thereof, which I lighted on at S. Albans, an antient garrison of the Romans, which I struck off from a Roman Brick, 'tis of the same colour and substance with what appears in ours at this day. And no doubt but this Glass was more frequent in their Brick than ours, for they tempered their earth two years together, and so it wrought more firm, and close; besides, they burnt them better. And this vitrification of earth made into Bricks, is not onely at the first burning of them, but also as Imperatus observes might be from great fires, to wit such as are in lime-Kils, and Potters Kils, such as were most Antient in Asia and Africa, for in those the Bricks
Observations on the Bricks usually Vitriified. But I have not heard nor seen any of them Vitriified in the firing of houses built therewith. For it seems that only a fire made with layers of dried crude Bricks burnt in the fire, can produce this effect, or else by the way of Reverberation in furnaces where most vehement close & continued fires are made.

This Glass lay long in the earth, though Helmont affirms that Glass there dissolves, putrefies and turns to water, in few years, which though true in our finer Crystal, as to the saline part, yet seems not so of Glass in general.

As for the way mentioned by our Author found out by Merchants, it seems not very credible, since the continual burning of Kili in Spain and Egypt, for Batillia and Polverine, and of Kelp, and other Materials for green Glass with us, in greater quantities than the said Merchants did to dress their provision, and consequently a stronger and more lasting heat raised thereby, did never produce Glass in any place or time whatsoever, nay the strong and close heat of the calcar, cannot produce it; Perhaps those that refine Metalls from the Ore, whereof Tubal Cain was the inventor or Antient Chymists, could not but both in their furnaces and from their Metalls long wrought upon by the fire, observe Glass also.
Epistle to the Reader.

Amongst those Chymists, the most antient seem to be Egyptian Princes, who all from Hermes Trismegistus downwards professed this art, indevouring at an universal Medicine, but not the supposed transmutation of Metals, as Kircher in his Alchymia Hieroglyph. affirms. Now this attempt could not be without great fires and furnaces, which must at some time or other run into Glass, and their materials also must do the like.

So that it plainly appears by what hath been said, Glass must be known from great antiquity. But the art of making and working Glass seems by what hath been said to be of later invention, and the first place mentioned for the making of it to be Sidon in Syria, which was enobled for Glass-houses and making of Glass, as Plin.l.36. cap. 26. And that Glass was made in the time of Tiberius (the first we read of amongst the Romans) 'tis apparent by the history of the man whom Plin. relates he put to death for making Glass malleable, of which hereafter.

Of the use of Glass.

In Domestick affairs it makes drinking vessels, infinite in fashion, colour, largness, the Romer for Rhenish wine, for Sack, Claret, Beer.
Observations on the Beer, plain, moulded, coloured in whole or in part, Bottles and other vessels to keep Wine, Beer, Spirits, Oyls, Powders, wherein you may see their Fermentations, separations, and whatsoever other changes nature in time worketh in any liquors, the clearness and goodness of them. Besides dishes to keep and to serve up sweet-meats, glasses to measure time, sleek-stones for Linnen, Ornaments for studies, and Presses, windows to keep us warm and dry, and to admit Light into our dwellings, which passing through coloured Glass, it tingeth with the same colour whatsoever lyeth in opposition to the Sun. And lastly Looking-glasses, the delight and business of Narcissus and his followers.

In Physick, Convex Spectacles for aged persons, and Concave Glasses for such as are Purblind, and cannot see unless the object be placed neer their eyes, contrary to the former, besides Cupping-glasses, Urinals, and to draw Womens-breasts, in preserving the eyes of En-gravers, and Jewellers, when they work some small and accurate work, and also for delight, in Magnifying, to make artificial eyes for Ornament, Diminishing, Dilating, Lengthning, and Multiplying Objects, and variously changing their figure, and Situation, and by various placing of them to work astonishment and fear
in the Vulgar beholder, as you may see in Schottus Opticks, Catopticks, Catoptrocausticks, Catoptrographicks, Dioptricks, and Telecopicks, who hath there collected out of Kircher, Porta, and other Authors whatsoever is rare and admirable.

In Astronomie, what strange wonders and discoveries have those Telescopes wrought, invented by Galileo or Scheiner (for they both contend about it) and since exceedingly promoted by Sir Paul Neal an honour to the English Gentry, and the most learned Hugenius, the incomparable Hevelius, and by Eustachio Divini at Rome? The use whereof hath made the Doctrine of the Heavens very clear, daily detecting new Stars and new Worlds, things wholly unknown to the ancients, besides their use by Sea and Land, for Sea-men, Souldiers, and all other Persons, to discern, and distinguish things at distance. Hereunto add that excellent Sphear of Glass, whereof Claudian writ that witty Epigram, which take Englished by M. Randolph.

Love saw the Heavens fram'd in a little glass, And laughing, to the Gods these words did pass,
Observations on the
Comes the power of Mortal cares so far?
In brittle Orbs, my labours acted are,
The statutes of the Poles, the Fates of things,
The laws of Gods the Syracusian brings
Hither by Art; Spirits inclos'd attend
Their several Spheres, and with set motions bend
The living work; each year the feigned Sun,
Each month returns the counterfeited Moon,
And viewing now her world, bold industry,
Grows proud, to know the Heavens her subject be,
Believe Salmonius, hath false thunders thrown,
For a poor hand is natures Rival grown.

The reason of this Fabrick, why made of glass Card, in his Book of Subtilties gives at large.

In Philosophy the Doctrine of Reflections, and Refractions, to discover the effects, and affections of air and water, and other liquours, and their various motions, in Tubes and Syphons. Experiments of a vacuum with Mercury, as also infinite experiments of rarefaction and condensation, in Thermoscopes, in the Hydraulicks, and Pneumaticks,
in the Florentine and Roman experiments, and also the Magdeburgical, which gave occasion to that rare invention of M. Boyle, whereby he hath demonstrated so many rare conclusions, and tryed so many singular experiments, which have made him famous here to all natives, as also to all foreign Embassadors and learned men abroad.

Neither may I omit Burning-glasses, nor those for the admission of species into a darkned room, whereby hath been taught the true nature of vision by Plempius and Scheiner, and also by other Glasses the demonstration of the generation of the Rain-bow by Des-Cartes.

Neither may I forget those Beads, Bracelets, Pendants, and other toys, which have procured us good store of Gold from Guiney, adorning the Noses, Ears, Lips, Rists and Legs of that nation.

Glass also affords us Ornaments for our houses and Churches, wherein all natural and artificial things are set out, to the life, in most glorious and Oriental colours.

We shall conclude with that Triangular Glass call'd the fools Paradise, though fit for the wits of wiser men, which representeth so lively Red, Blew, and Green, that no colours can compare with them. And shall relate out of Targaultius
Observations on the

230

gaultius in what great account the wisest nation accounted the Chineses had of them, Riccius the Jesuite fell sick at the City Tanian in China, of a most dangerous sickness. But his friend Chiutaiso performed so good offices to him, that within a moneth (which time he staid there) he recovered his strength so well that he seemed stronger than he had been before.

Riccius recompensed his friends civilities amongst other presents with a Triangular Glass, wherewith he was much delighted, and to add some State to the Glass, he put it in a Silver case, and fastned Gold chains to the buttons at the end of it, writing an elegant Encomium on it, whereby he endeavoured to prove that this Gem was a fragment of that matter whereof the heavens are made. These ornaments caused many to desire it, for not long after one is said to have offered five hundred Crowns for it. But he then refused to sell it, though he much desired to do so for this reason only, because he was not ignorant that such a Glass was a present for the King, and he feared the buyer would prevent Riccius by sending it to him, and that the novelty being pass'd, it would be less esteemed by that Emperor. But afterwards when he knew that such a gift had been presented to the King,
and having somewhat encreased the price, he sold it, and with that sum paid many debts, and thereby obliged his society.

Concerning the malleability of Glass, whereon the Chymists build the possibility of making their Elixir, take their weak foundation from Pliny, lib. 36. cap. 26. They report, saith he, that when Tiberius was Emperor, there was invented such a temperament of Glass that it became flexible, and that the whole shop of the Artificer was demolished, lest the prices should be abated of the metalls of Brass, Silver and Gold, and this report was more common than certain. Now Pliny liv'd in the time of Vespasian, who was the third Emperor from Tiberius, so that it appears this report continued long. Many after him relate the same, though with some difference. Dion Cassius, lib. 57. thus, At that time when a very great Portico at Rome inclin'd to one side, a certain Architect (whose name is unknown, because Caesar through envy forbid it to be registred) strangely set it upright, and so firm'd the foundations on every side, that it became immoveable; Tiberius having pai'd him banish'd him the City, but he returning (as a supplicant) to
Observations on the

the Prince, wittingly let fall a cup made of Glass, and when it was broken remade it with his hands, hoping thereby to obtain pardon; but for this very thing he was commanded to be put to death. Isidorus affirms that the Emperour in a chase hurl'd it upon the Pavement, which the Artist took up being batter'd, and folded like a vessel of Brass, he then took a Hammer out of his Bosom, and mended the Glass, which being done the Emperour said to the Artist, doth any one else know this way of making Glass? when he had denyed it with an oath, Caesar commanded his head to be cut off, lest this being known, Gold should be esteemed as dirt, and the prices of all metalls should be abated. And indeed if vessels of Glass did not break they would be better than Gold or Silver. These three grave Authours, Pancirol-lus and others follow, onely telling it as a hear-say; but Mathesius, Goclenius, Valensi, Quatriami, Libavius, and all the tribe of the Chymists, assert it with great con-fidence, affirming that it was done by the vertue of the Elixir; but for all this confidence of theirs, Pliny onely relates this story with a certior, they report, and with a certior, the report was, and thirdly, crebrior quam certior,
Epistle to the Reader.

more common than certain. Which thrice repetition of such like words, sufficiently argue his small belief of the story. It had been enough to have introduced this improbable relation the usual way with a ferunt, and hereby sufficiently have provided for his reputation, but he superadds de proprio, fama crebrior, &c. Which at most proves only that some small credit was by some few given to it, but ex vi verborum a disbelief in the wiser sort. For what can such words as these (they say such a thing, but the report is most uncertain) import, but a diffidence in the relator? And 'twas but a fama, no Naturalist, no Poet, nor Historian deliver it, no record of the person, nor unusual punishment, which is strange, when their Books abound with observations of whatsoever rarely happened. And is it probable that the Emperor himself should not lay up this Glass as a secret in his choicest Archives, and have transmitted it down to his successors, as a thing worth the keeping, being the first of that nature ever made in the world, and perhaps the last, the Artist being put to death? And yet within a few years all this most rare invention, and strange punishment vanish into a report only. All then was but vox populi and Romani too, nay, of the cruelty
Observations on the cruelty of a Nero too, all which might easily keep up this Fable. But why did Pliny then relate it? Surely, to please and follow his genius, which was to commit to writing whatsoever was rare in Art and Nature, as his nephew in his Epistles, and this present work witness. Now on this account he might take occasion, in a thing perhaps he judged not impossible, to commend that present age (should after times produce any such effect,) and so ascribe the invention thereof to his own nation. Besides 'twas but such a temperament of Glass that rendered it flexible. And is it credible that after ages should not light on't, especially in a thing so commonly practised, and whereto so few, but two materials only are required? Or what means, fame, by the undervaluing of Gold and Silver? I confess I see no inconvenience to the Emperour, nor his Gold and Silvers value, by this invention, but many ways advantage, nor any force of consequence in Caesar's words. But so much of Pliny's testimony. And what shall the borrowers from him gain more reputation than the first relator gave it? Surely no, especially since they have made such a commentary on Pliny's text the words will not bear, and have with additionals moulded it into a formal relation.
Epistle to the Reader.

Pliny saith, ut flexibile esset, that it might be flexible. Dion comments, the man remade a broken Glass, One degree to malleability, but Isidorus completes it saying, with a Hammer he mended it. Hereby you may see the degrees how this opinion came into the world, and by what strange piecings variations and interpretations, it hath been fomented to make that seem credible to after ages, which Pliny relates as a vulgar tradition, adding thereto a censure of uncertainty. Which the Chymists to keep up the opinion of their Omnipotent Philosophers stone, omit, and turn Plinys flexibility into malleability. As if there were no difference betwixt flexible and malleable. Whereas all bodies are in some degree, or other flexible, though none but mettals malleable. A green stick, Muscovie Glass, and infinite other things will bow very much, whereon the Hammer, notwithstanding, hath no effect as to dilatation, and formation into thin plates, such as things call'd properly malleable have. And that Glass is in some degree flexible of its self 'tis apparent, for fine Crystal Glasses made very thin, and well annealed, will bear some small, yet visible bending. And I have had Tubes made twelve foot long and longer for the Mercurial experiment,
Observations on the experiment, which being filled therewith would bend exceedingly. So that I am prone to think that if there were any thing at all in this narrative of Pliny it might be this, That whereas their Glass before this time was most brittle, as being made of Salt-peter, and the art of annealing it (not mentioned by Pliny) unknown and consequently must break with the smallest force; Now this Artist might invent and shew such Glass as might accidentally bear a fall, or greater force, than what was formerly made, by making it of Kali, and superadding the way of annealing it, which might give occasion to fame, whereas Virgil, parva metu primo mox se se attollit in auras, to add some circumstances (which is most common with the vulgar) and so to form this story related by Pliny.

Now as to the possibility of making Glass malleable, I find not one argument, besides this report, unless by the Chymists who prove it per Circulum, reasoning from their Elixir to Glass, and from Glass to the Elixir. And surely 'twere more feasible to make the one than the other. For in the making of the Elixir the production is tale ens ex non tali ente, there being no resistance, and incapacity in the matter ex qua. But in Glass's quite other-
otherwise, for 'tis of its own nature the most brittle thing in the world, and to make it malleable a quality quite contrary to its nature must be introduced. Besides diaphaneity is a property not communicated to anything malleable, and who would call that Glass, that were not transparent? As well may one name that Gold which is not ponderous nor malleable, as that Glass which is malleable and not transparent. Add henceto, that the nature of malleability consists in a close and throughout adhesion of parts to parts, and a capacity to the change of figure in the minutest parts. Both which are inconsistent with the nature of Glass. For the materials of Glass, Sand, and Salts, have such figures as seem incapable of such adhesion in every part one to another. For all salts have their determinate figure which they keep too, in their greatest solutions and actions of the fire upon them, unless a total destruction be wrought upon them, as many instances might evince, and that figure is various according to the Salts. Saltpeter, and all Alcalizate-salts are pointed, and by their pungency, and caustickness seem to be made up of infinite sharp pointed needles. And as for Sand the figure thereof is various, nay, infinite, as it appears in Microscopes.
Now how can any man imagine that such variety of figures in Sand can so comply with the determinate figures of Salt as to touch one another in minimis, which is necessary to make it malleable? Whereas to make it Glass 'tis enough that those two touch one another at certain points onely, whereby such an union is formed, which is necessary to denominate Glass, but wholly incompatible with malleability. And this union is that which makes in Glass Pores, from whence comes it's diaphaneity as you have heard from Lucret. Besides something said before, declares that they both remain the same in the compound they were before. I shall conclude this argument, and say, that I conceive that nothing but the Elixir will perform this effect, and that both of them will come into the world together.
Of the Furnaces.

Before we enter upon the Art it's self, 'tis necessary to deliver the manner of their Furnaces, and their several instruments, and also how their Metalls when refined must be wrought, all which are pretermitted by our Author, though necessary to be known by the Reader. There are three sorts of Furnaces as Agric. de re metallica distinguisheth them. The first the Calcar, fornax calcaria, is made in the fashion of an Oven, ten foot long, and seven broad, where widest, and two foot deep. On one side thereof, they have a trench about six inches square, the upper part whereof is level with the surface of the Calcar, separated onely from it at the mouth by bricks some nine inches wide. Into this trench they put their Sea-coal, the flame whereof passeth into all the parts of this Furnace, and reverberated from the roof upon the Frit, over whose surface all the smoak flieth very black, and goeth out of
Of the Furnaces.

240

Of the mouth of the Calcar. And the Conciator never stirrs his Frit till the smoke is past. The Coals burn (as in other Furnaces) on Iron grates, and the ashes fall thence into the ashole, which is level with the floor. The Conciator (call’d in the Green-glass houses the Founder) is he that weighs, and proportions the Salt, or ashes, and Sand, and works them with a strong fire till they run into lumps, and become white, and if the Metall be too hard, and consequently brittle, he adds salt or ashes, and if too soft, sand, still mixing them to a fit temper, which is only known by the working of it. According as the Frit is prepared, he draws it out of the Calcar, and when ’tis cold lays it by for use. He doth not here cast water upon the Frit, nor water it with Lee, as our Author enjoyns, and after some few days useth this Frit to make metall. Which when ’tis melted in the pots, in the working Furnace, with a square, he rakes and stirs and mixeth well the Metall, when the square is red hot, he puts it into a pail of water, for otherwise the Metall will stick to it. With a Ladle he takes out the Sandever, or empties the Metall from one pot.
of the Furnaces.

pot into another. And with his Porteglo he cums the Glass, and with the Spiei (an Iron pointed and hooked at the end) he takes Metall out of the pots for proofs or Essays, to see whether the colour be good, and the Metall fit to work. Some anneal their pots in this furnace, as Agric.

The second or working furnace is that where the pots are set, to which belong the fire place, and ash-hole. This Furnace is round, of three yards Diameter, and two in height, arched above, round about the inside whereof, 8 or more pots are set, and on these the piling pots; the number of the pots is always double to the working Boccas, that each Master may have one pot refined, and to work out of, and another for Metall to refine in whilest he works out the pot which hath refined in it; it hath two partitions, the lowermost separateth the pots from the fire place, in the center whereof there's a circular hole made with Iron grates fourteen inches or more in diameter, through which the flame passeth from the fire-place into this furnace, from whose arched sides and roof 'tis reverberated into the melting pots; the second partition divides this from the Leer.
Of the Furnaces.

to this furnace belong these holes, first, Bocca, the working hole, by which the Metall is taken out of the great pots, and by which the pots are put into the furnace, this is stoppt with a cover, made with lute and brick, removable at pleasure, to preserve the work-mens eyes from the vehement heat of the fire; this hath a hole in it more than a palm wide, by which the vessels are scalded as often as 'tis needful. To this Bocca belong the Halsinella's which are certain hooks, fastened to the sides of the furnace, whereon to rest and turn their vessels when they scald them. 2. Boccarellas, one on each side of the Bocca, lying almost Horizontally with it, out of these the Servitors take coloured or finer Metall from the piling pot. 3. Ovens or holes next the Leer to calcine Tartar, Iron, &c. One on each side lying level with the Bocca. To this also belong the fire place, having two Tizzonaios or stitches, one on each side of the furnace, by which a Servitor night and day puts in Coals to maintain this Vestal fire. These are made with Bricks. These furnaces are variously made in several places, and to strengthen them are arched with five or more arches, yet all three
Of the Furnaces.

three are necessary in all Crystall Glass-houses. See variety of them, Agric. de re Metall. l. 10. Libav. Comment. Alchem. part. i. l. i. c. 20. Ferant. Imperat. l. 12. c. 14, 15. Porta l. 6. c. 3.

The Green Glass furnaces are made square (whereas the former are circular, but where the Leer takes off an arch thereof) having at each angle an arch to anneal their Glasses.

The Leer (made by Agricola, the third furnace, to anneal and cool the vessels, made as the second was to melt the Metall, and to keep it in fusion) comprehends two parts, the tower and leer. The tower is that part which lies directly above the melting furnace with a partition betwixt them, a foot thick, in the midst whereof, and in the same perpendicular with that of the second furnace, there's a round hole (Imperat. and Agric. make it square and small) through which the flame and heat passeth into the tower; this hole is call'd Occhio or Lumella, having an Iron ring encircling it call'd the Cavalet or Crown; on the floor or bottom of this tower the vessels fashioned by the Mrs are set to anneal; it hath 2. Boccas or mouths, one op-
Of the Furnaces.

posite to the other, to put the Glasses in as soon as made, taken with a Fork by the Servitors, and set on the floor of the tower, & after some time these Glasses are put into Iron pans (Agric. makes them of clay) call'd Fraches, which by degrees are drawn by the Sarole man all along the Leer, which is five or six yards long, that the Glasses may cool Gradatim, for when they are drawn to the end of the Leer they become cold. This Leer is continued to the tower, and arched all along about four foot wide and high within. The mouth thereof enters into a room, where the Glasses are taken out and set. This room they call the Sarofel, and the Sarole-men those who draw the Fraches along the Leer, and take them thence.

For green Glass on two opposite sides they work their Metall, and on the two other sides they have their Calcars, into which linnet holes are made for the fire to come from the furnace, to bake and prepare their Frit, and also for the discharge of the smoak. But they make fires in the arches, to anneal their vessels, so that they make all their process in one furnace onely.

The stones wherewith the inside of these furnaces
Of the Furnaces: 245

Furnaces are not brick, (for these would soon melt down into Glass, as also other softer stones) but hard and sandy, which Imperat. calls Pyramachia, such are brought from New-castle, they will strike fire, one being struck against another, and are of a whitish colour. And yet this hard stone frequently rends in a quarter of a year, or else furrows will be made in them. The outside of these furnaces are built with brick. The heat of those furnaces, is the greatest that ever I felt, and I have observed straws put in three days after the extinction of the fire soon converted into a flame. The workmen say 'tis twice as strong as that in the other Glass-furnaces.

The melting-pots come next to be treated of, and are made of clay fetched from Purbeck in the Isle of Wight, the very same which makes Tobacco pipes. This clay being well washed from all impurities is calcin'd in a furnace for this purpose, and then ground in their Mill into a fine powder, which being mixed with water is trod with their bare feet till it come to a good consistence, fit to mould, which they do with their hands, and when fashioned, dry them in a convenient place, and afterwards anneal.
Of the Furnaces.

neal them in or over the furnace. But those for Green Glass are made of Non-such clay, mixed with another clay brought from Worcestershire, which bears the fire better than that of Non-such, but both together make the best pots. These pots are fill'd with Metall, and stand level with the Bocca.

Two sorts of pots are used in Crystal furnaces, a greater which will hold three or four hundred weight of Metall, these are an inch thick, and at the bottom, near two, deep two foot, and above twenty inches broad at the top, but much narrower at the bottom. The second sort of pots they call piling pots, because set upon the greater, into which they put their finer or coloured Metall for vigarines or other works.

The last business will be to shew the manner of working Glass, which take from Agric, de Metall l. 2. with some additions. The Servitor when the Metall is sufficiently refined, puts his hollow Iron into the pot, and turning it about, takes out enough for the vessel or work it is intended for, the Mettal sticks to the Iron like some glutinous, or clammy juice, much like but more firmly than Turpentine or Treacle taken
taken by tradesmen out of their pots. The figure it takes on the Iron, is roundish, and whilst 'tis red hot the Servitor rouls it to and fro on a Marble that the parts thereof may be more firmly united; And then gently blowing into his hollow Iron raiseth the Metall just as blowing doth a bladder or glove. As often as he blows into the Iron (and that must be very often) so often he removes suddenly the Iron from his mouth to his cheek, lest he should draw the flame into his mouth, when he reapplies it to the Iron. Then he takes his Iron and whirls it many times about his head, and so lengthens and cools the Glass, and if it be needful for his designs, moulds in the stampirons or flats the bottom by pressing it on the Marble; And then delivers it to the Master workman, who with a gentle force breaks of the collet (which is that part of the Glass which cleaved to the blowing Iron, and casts by to make Green Glass) and with his pontego sticks the Glass and scalds it, and with his passago makes the boule of the Glass, then with his procello widens and makes it hollower and more capacious, and with the spears cuts off what's superfluous, and
Of the Furnaces.

withall making it plain and even. And thus with blowing, pressing, scalding (which must be repeated as often as the Glass cools) amplyfying, cutting, &c. frames it into the shape preconceived in his mind, And when need requires fastens on feet and handles, and with the Spiei puts on Riga-vines and Marblings, and when the Master finisheth them another Servitor takes them, with an Iron fork, and speedily placeth them in the tower to anneal, mounting up by a step for the more convenient placing of them, unless by a stumble in the way he chance to break this ware, then most brittle and tender, nay, that will break of it's self without this annealing. So many Masters as there are so many pots at least, and so many Boccas or holes there must be, for each man hath his proper station. Where they receive those scorching heats sallying directly into their faces, mouths and lungs, whence they are compell'd to work in their shirts like the Cyclopes and nudi membra Pyracmons, with a straw broad brim'd Hat on their heads to defend their eyes from excedency of heat and light. They sit in wooden large and wide Chairs with two long Elbows,
Of the Furnaces.

whereon they hang their instruments, fastened so that 'tis immovable. They work six hours at a time measured by one Glass only, and then others succeed them, and when these latter have wrought their six hours the former return to their labour, and by this means the furnaces are never idle, whilst they are in good condition, and the pots break not, and the fire keeps the Metall in fusion. Libavius observes that they are for the most part pale, thirsty, and not very long lived, by reason of their colliquations, and the diseases of their head and breast, & that having their bodies weak, they are soon fuddled with wine or bear. A very true Character of them.
Observations on the first Book.

Having now dispatched what was necessary to be premised, we come to the text it's self.

Polverine or Rochetta, are the same thing, and are nothing more than ashes extracted from the same plant, but differing in goodness, as appears by our Author in several places. The name of the latter is wholly unknown to our Glass-houses, and hath now no distinction at Moran it's self. The name of Polverine still is kept, and 'tis given to all ashes which come from the Levant to make Glasses with. The reason then of their different names seems to be, that the Polverine was that which was brought in small powder, and the other in hard pieces or stones, and therefore named Rochetta. And indeed the workmen observe that the harder and bigger lumps yield a whiter and stronger salt than that which comes over in small pieces or powder. And whether this
this proceeds from the different sorts of this kind of plant, or the seasons of their growth, gathering and burning, or from some sophistiation from other salts mixed therewith, or rather from sea-salt water, or other moisture which much endamageth them, I determine not. But certain it is, that to make the strongest salt, and such as will come into hard and stony lumps, they make a Lee of their first burnt ashes, and therewith water the herbs to be next burnt, and so water the herbs with new Lees at every burning, and this will make a most strong pot ashes for Soap-boylers, and Dyers. Which way whether it hath been practised to make Rochetta, and now omitted I cannot affirm.

Comes from the Levant and Syria. Syria is part of the Levant. Now these ashes are brought from Alexandria and Tripoly.

A certain herb. This herb be names in his Epistle Kali, and 'tis so call'd by most Authors, but with some small variation, as Kalli, and Kallu, by Alpinus, in l. de plant. Egypt. by some Cali, Alkali by Gesner, Soda by Lobel, Salicornia by Dodon, Sallola, by Dodon Gallice, and Hift. Lugd. Anthyllis, by Camer. Cordus, Fuchs. and Lusitanus, the two latter whereof confidently assert it to be the Anthyllis of Diosc. both which Matthiolus
Observations on the first Book.

Thiolus hath fully refuted in his apologie against Lusitanus, who saw this plant grow at Tergestum in Mauritania, and lastly, Antyloides, by Thalius. Soda, Salicornia, and Salsola manifestly derive their name from Salt, wherewith they all exceedingly abound. Of the Antiquity of knowledge, and names of this plant with us, thus our learned Country-man Dr. Turner in his Herbal. As I remember it hath no name in English, and though it be very plenteous in many places of England, yet I could never meet with any man that knew it; but lest this herb should be without a name, it may be called Salt-Wurt, because it is salt in taste, and Glass-weed, because the ashes of it serve to make glass with.

Parkinson saith, that 'tis call’d by the inhabitants of our Sea-coast, Frog-grass, and Crab-grass, perhaps because those animals feed thereon, being a very juicy, substantial, and not of an unpleasant saltish taste. Gaspar Bauhin in his Pinax makes ten sorts thereof, whose names and descriptions we omit, as too long for this place. I shall only mention those three wherewith the Alexandrians, and other Egyptians make their Powdernine for Glass, and Soap, as Alpinus chap. 42. delivers them.

The first is Kali geniculatum, the second sort Kali
Observations on the first Book. 253

Kali secunda species, and Anthyllis quibusdam, by Alpin, but by Columna Kali Florid. repens Neapolitanum, who found it at Naples, and figures, and describes it, and faith 'tis used to make Glass. The third sort more peculiar to Egypt is call'd by the same Author Kali Egyptiacum foliis valde lonicis hirsutis. And besides these three, I have seen, and have by me a fourth, taken from their Polvereine bags call'd Kali spinosum by the Herbarists. The first and last of these (besides the minus and minimum) our river Thames, and Sea-coasts affords in great plenty, but in no Countrey more Northerly than England, yet ours will not make ashes for Crystall, or any other sort of Glass, as an experiment made at the Glass-house taught me, for ours being put upon an Iron heated red hot smoaked all away, leaving little or no ashes at all thereon: But the Kalies brought from the Levant, put on the same Iron, soon converted almost all of them into a very saltish ashes of a dark ash their proper colour, these in burning contracted themselves like worms, flame long, and make a white and very strong salt. Our Kali when gathered appears to the tast very brackish and salt, and will being laid in moisture, contract it self into a small dimension, which a
Observations on the first Book.

Confectioner whom I know found to his loss, who bought thereof instead of Samphire, For having washed it, and put it to vinegar to pickle, found very little of his Samphire remaining, for the Vineger had well near devoured it all. This great difference of plants in respect of the country may be manifestly perceived in many other plants as well as in these Kalies. As in Tobaccoes arising from the same seed, and in Canary and Rhenish wines from the same stock, in the Hemlocks of Greece, and those of other countries, and in multitude of other examples, and this reason differenceth Polverine and Barillia. These Kalies though natural denizens of the water, and flourishing naturally neer salt lakes, yet are planted on land in Spain and Egypt, which doubtless contributes much in those hot regions (especially in Egypt where no rain falls, but the Country is onely watered once a year, by the rising of the river Nile, leaving much fatness and soil behind it) to the quantity, strength, and fixedness of the salt. Now these Kalies about midsummer, when in their full strength, are cut down and dryed in the Sun, and then burned, being laid in cocks or piles, either upon the ground, or upon iron grates, the ashes whereof fall thence into
Observations on the first Book.

a pit where they grow into a hard mass or stone, & are gathered and laid up for use & are call'd Sode as Lobel affirms. When these plants were first taken notice of is uncertain. The first that took notice of them, and gave them their name, were the Arabians, as also to their salt, as appears by their addition Al which is purely Arabick. Amongst them I find it mentioned by Serapio and Avicen the Physicians, who both commend it for the Stone, Ulcers, and diseases of the eyes. Lobel thinks that we owe the plant, name, and way to make the Salt to the latter Græcians or Arabian Philosophers Chymists that wrought in Glass. Advers. pag. 169. But as to the Græcians, and their knowledge of it, I cannot consent, because 'tis not mentioned by any of the Greek Physicians or other writers, besides it hath not yet attained any name in that language, and therefore doubtless the Arabians of latter times have conveyed the knowledge thereof to us.
Chap. 1. To know the quantities and strength of the Salt. The best and readiest to know this, is that practised by the Soap-boylers, in their Effay-glasses. They dissolve their Soap-ashes in fair water, and filter the Lee, and weigh it again, and so by measuring the quantity of the Lee, and comparing it with the weight of the water and ashes before they were dissolved, they find how much Salt such a quantity of ashes contains.

Brass Coppers. Our Author everywhere forbids the use of Brass and Copper, unless where Green, or Blew colours are to be made. And certainly these strong Lees will fret off some part of the Copper, or else the moisture of the air and Lee will turn part of it into Verdigreas. And therefore here they use only Boylers lined on the inside with Lead, such as the Alume and Copperas makers employ to extract their Salts in.

Tartar of red wine Calcin'd. Tartar call'd by our Author Greppola and Grumidi botti, which are indeed the Lees, and are to be distinguished from the Tartar it's self, this sticking to the sides of the vessel in thick
and hard lumps, and (as Helmont saith) is
never to be found in the region of the Lees,
whereas they on the contrary are always found
at the bottom of the vessel, moist and in small
pieces only. Tartar of red wine best for this
use, because it contains a stronger Salt, and
more in quantity than that of white wine.
'Tis calcin'd, to burn off all Heterogeneous
bodys mixt therewith, and to make the Salt
whiter, and for the speedier dissolution of it
in the water, and better extraction of the Salt
from the Powderine, whose body is opened by
the Tartar, as Alume or Vitriol open the
body of Salt-peter, in making Aqua-fortis or
Spirit of Nitre, which otherwise without such
like addition would not rise. And for the
same cause the Tartar must be dissolved in
the water before the Powderine is put into
the boyler. They Calcine their Tartar in an
Oven, near the Lees, in the space of six hours,
and that to whiteness too, finding that this
bath a better effect, than a meaner calcination
bath. What advantage the drawing off the hu-
midity of the Tartar gives, a secret way u-
sed by some Chymists doth demonstrate. To
make their Crystallats and Cream of Tartar,
larger, and whiter, they powder it grossly, and
then Calcine, or rather dry it thoroughly in an
Oven.
Observations on the first Book.

Oven, in tin pans. And thus they make them much better, than they can be made without this drying, or moderate Calcination.

The Salt sinks to the bottom of the boiler, and is taken out with a scummer, from which drain all the moisture, and let it run into the boiler; when the faces of the Lees have settled to the bottom of the tubs, they draw them off with a Siphon.

Chap. 2. The second material, and that which gives consistence and body, and firmness to Glass, is sand or stones. As Iron gives to English Copperas, and Copper to Hungarian, Dantzick, and Roman Vitriol, which otherwise would run into water in moist places and seasons. Concerning these stones, Agric. l. 10. saith, They must be such as will melt, and of them, those which are white, and transparent are best. Wherefore Crystals challenge precedency, For of these broken, Plin. saith, Authors affirm, that Glass is made in India, so excellently transparent, that no other may be compared with it. The next place, they give to those stones, which though inferior to Crystall in hardiness, yet are white and transparent, as that
Observations on the first Book.

that is, The third place is given to those which are white, but not transparent. Next to Tarso our Author commends Quocoli, rendered Pibles, which Ferant. Imperatus, l. 24. c. 16. thus describes, The Glass stone is like in appearance to white Marble, partaking of transpareancy, differing from it in hardness, which it hath as much as flint, whence 'tis that being struck, it sparkles, and put into the fire, turns not to Lime. This stone most commonly partakes of a light Green, like the Serpentine stone. 'Tis found in its natural place clad and mixed with veins of crusted Talk; when 'tis first put into fire it loseth it's transpareancy, and becomes white, and lighter, and afterwards it turns into Glass. 'Tis wrought by the Glass-men, as a material of Glass under the name of Cuogolo. Because they gather them in the bottom of rivers, and torrents, in the form of round pibles or shards. And those are they our Author saith are used at Muran. 'Tis without controversy that all white and transparent stones, such as will not become lime, serve well for Glass; but our Authors axiom is not wholly true, for neither the stones from New-castle, mentioned in the Glass furnaces, nor fire-stones, nor rance stones, and many other which strike fire
Observations on the first Book.

With a steel, or horse shoes, and Coaches wheels, will not serve to this purpose. Flints indeed have all the properties, and when calcined, powdered, and ferced into a most impalpable powder, make incomparable pure, and white Crystal Metall. But the great charge in preparing them hath deterred the owners of our Glass-houses from farther use of them.

Sand is made use of where fit stones cannot be had, and according to our Authors story, were first used; it must be white, and small, and well washed before used, which is all the preparation of it. Such is usually found in mouths and sides of Rivers; for Crystal requires a fine soft and white sand, but Green-Glass, that which is harder, and more gritty.

And there is great variety in this material, for some soon melts, and mixeth with the ashes, and becomes Glass. Joseph. 1.2.c.9. of the wars of the Jews relates strange things of Sand, which is briefly thus. Neer Ptolemais a city of Galilee, runs the river Belus, arising from mount Carmel between Ptolemais and Tyrus. Neer this small river is the Sepulchre of Memnon, having neer it a space almost of 100 cubits most worthy of admiration. For there's a valley round in shew, sending forth Sand.
Observations on the first Book. 261

Sand for Glass, which when many ships coming together have exhausted, the same place is presently filled again. For the winds as it were on purpose, bring from the circumjacent sides of the mountains this Sand. And the place where the metal is, presently changeth into Glass what it hath received. And this seems more strange to me, that the Sands converted into Glass, whatsoever part thereof is thrown into the skirts of that place is again changed into common sand. And Tacit. 1. 5. Hist. Belus runs into the Jewish Sea, about whose mouth Sands are gathered (Lipsius reads it Collectæ not Conjectæ) which having Nitre mixed with them are boil'd into Glass. That shore is small, but unexhaustible by them that fetch it. The same thing witness Strabo 1. 12. Plin. 1. 6. Agric. de foss. All Authors that write of Glass, mention those places whence the Sand is fetched. Our Glass-houses in London have a very fine white Sand (the very same that's used for Sand-boxes and scouring) from Maid-stone in Kent, and for Green-glasses, a coarser from Woolwich. The former will not mix with ordinary green metal. Both these cost but little besides their bringing by water.
Cardan I. 5. de variet. adds Manganese, called by him Syderea, as a third ingredient into Glass. Constat (faith be) Vitrum ex tribus, to wit, of stones or sand, of the salt of Cali, and Syderea; but the small quantity of Manganese added to the metall, can contribute little to a pot of metall. Besides 'tis not used in all sorts of Glass.

Chap. 3. S

Hews but the common way of Chymists, by solution, filtration, and coagulation to make fixed Salts.

Chap. 5. M

Ust be cur, &c. All plants have their time to be cut or gathered, that is, when they are in their full growth and strength. The best time is a little before they are in full flour, and that to all purposes, to which the leaves or stalks are used, and also in Chymistry to extract the oils of Vegetables, and Spirits, which then are produced almost in double quantity more than at other times, but for Salts when the herbs are in seed, as Fern is at this time. 'Tis a Vulgar error, that Fern and other capillary herbs have no seed, which they have in great quantity on the back sides of their leaves, in form of dust, of a brown
Observations on the first Book.

Mosses also abound in seed, as it is most evident in an undescribed kind of Chamapeuce I keep in my horto sicco, all whose branches, and betwixt each leaf thereof are multitudes of round and brownish seeds. How much also the seasons of the year difference Vegetables, the Button-mold-makers can inform you, in those woods they make molds of, who find that Pear-tree cut in Summer works toughest, but Holly in the Winter, Box works hardest about Easter, but mellow in the Summer, Hawthorn works mellow about October, and Service tough in the Summer.

Chap. 6. Gives an account of other plants, which yield a Salt fit for Glass. In one word, whatsoever Vegetables afford quantity of Alcalazite salts (for so the Chymists call such as will persist in, and bear a strong fire, without flying away, and vanishing in the air, and are so denominated from Alkali, that is Salt drawn from Kali) are good to make Glass. Some whereof this Chapter enumerates. Kelp so named from Kali, and pot ashes are used for Crystalline metall. Kelp is principally made of that Sea-plant we call Sea-thongs or Laces,
Laces, and from its use by Joan. Bauh. lib. 39. c. 2. de Hist. plant. Alga angustifolia vitrariorum, which being kept moist a little after gathering, will shew afterwards, though long kept, it's white salt on the surface of it's leaves. Math. in Diosc. calls it Algam vulgarem Venetorum, the common Sea-wrack of the Venetians, not only for the reason before, but also because the Venetians wrapt up their Glasses therein, which they sent to foreign parts. This wrack when the Sea is tempestuous, scopus illisa refunditur Alga, as Virg. is thrown and scattered upon the Rocks, in great abundance, and also on the shoar, which the country people in the summer rake together, and dry it as they do hay, by exposing it to the Sun and Wind, and so turning it as occasion serves till 'tis fit to burn, and make these ashes call'd Kelp, used as well to make Alume as Glass.

Nor is this particular wrack alone used, though very much abounding in all our Seas, but also all other Algas, fucus & quercus marina, and other Sea-plants, all which abound in Salt. Pot-ashes come from Poland and Russia, and New-England, and are the ashes for the most parts of Firs and Pines. For Green-glasses in England, they buy all sorts of ashes confused one with another, of persons who go up and down the
Observations on the first Book.

Countrey to most parts of England to buy them. But the best and strongest of all English ashes, are made of the common way Thistle, though all thistles serve well to this purpose. Next to Thistles are Hop-strings, that is, the stem and branches of Hops, cut after the flowers are gathered, these two are of late invention. Bramble-bush yields the best Salt among trees, and Genista Spinosa, and Hawthorn next that, and Kali Spinosum amongst the Sea-plants. So that it seems that those plants which are thorny and prickly afford in their kind the best and most Salt. Next to the forementioned are all bitter herbs, as Hops, Worm-wood, Carduus benedictus, Centauries, Gentians, Southernwood, Tansey, Woad, &c. could store of their ashes be procured at small charges; add to these Tobacco, which affords abundance of Salt, the stems being gathered and burnt, and might turn to great profit, though some damage to the soil. A Merchant told me, he offered to King Charles the first, that he would erect and maintain at his own charges Churches, and endow each thereof with 100 per annum, only for the stalks of all the Tobacco which grew in Virginia, and did demonstrate to me the great profit would arise to him by this Patent.
Observations on the first Book.

In the next place follow all Leguminous plants, such as bear Peas, Beans, &c. which have some affinity with the other tribe, especially Lupins, Fetches, Cicers, and Lentils, the last whereof being lately sown plentifully in Oxford-shire for their cattle, have been found by experience good to this effect. Add amongst the milky plants, all the sorts of Tithymals or Spurges, and Fig-tree, which have a blistering faculty in them, and the Vine-branches, and Sow-thistles, which are somewhat prickly and downy flower'd, wherein they agree with thistles, and have a milky juice, as Tithymals have. Now concerning these fixed Salts, observe, that those are best, which are freest from earth, sticks, and all other Heterogeneous bodies, and are in the hardest and whitest lumps, and to the tast most sharp. Secondly, the best ashes being most full of pure and unmixed Salt soonest run in the Calcar. Thirdly, That ashes made with Vegetables, when in their full growth, and of the most flourishing branches of them, are best. For from hence the Chymists seem to derive their name of Cineres clavellati, from Clavola, instead of Clavolati. Whereof Varro l. i. de re rust. c. 40. thus. In oleagineis feminibus vi-
dendum, ut sit de tenero ramo ex utraque parte
parte æquabiliter præcisum, quos alii clavolas alii taleas appellant ac faciunt circiter pedales, where he expounds Clavola by tender branches. Nonus reads it Clavula, and defines them the cutting of wood. Certain it is that Clavola or Clavula comes from Clava which is our Club in English. Fourthly, These Salts must be kept dry, for moisture, and wet much endamage them. Lastly, some of these ashes make whiter Glass than others. Oak ashes partaking of a Vitriolate nature make Glass of a darker colour, and Ash-tree, and Hawthorn, communicating in their Salts with Niter, render a more whiter metall than the former.

Agricola thus of the Salts make Glass, The first place must be given to Salt-peter, the second to white and transparent Fossil Salt, the third place to the Salt of the ashes of Anthyllis or other Salt herbs; some there are who give precedence to the ashes of Anthyllis or Kali, and not to Salt of Nitre. But those which want make Glass of two parts of the ashes of common Oak, or the Ilex or Scarler-oak, or Cerrus the Bitter-oak, or for want of them with the ashes of Beech or Fir, with one part of gravel or sand, and they add a little Salt extracted
Observations on the first Book.

Extracted from Sea Salt-water, and a little Manganece, but these ashes make a Glass less white and transparent. Now these ashes are to be made of old trees, whose trunk when grown to six foot high is hollowed, and fire being put into the cavity, the whole tree is burnt down and turn'd to ashes. This is done in the winter, when the snows have long continued, or in the Summer when it snoweth not. For rains at other seasons of the year make the ashes foul, by mixing earth with them. Wherefore in the winter they make ashes of those trees cut into schides and burnt within doors. So far Agric.

But time and experience have worn out the use of Salt-peter, and Fossil Salts, which have given the priority to Polverine, being too soft and gentle, whereas Glass requires Lixivial, and fixed Salts, that have a Caustical, and strong tast, and but little Unctuosity, whereof Nitre and Fossil Salt have store, and therefore run most of them into Sandever, unto which Nitre comes somewhat neer in tast and fattiness. But Agric. and other Authors seem to mistake Pliny, who puts Nitre for those Alcalizate Salts, for so lib. 31. cap. 10. Quercu crematâ nunquam multum nitrum factitatum est, never much Nitre was made of Oak.
Observations on the first Book.

Oak burnt. And Virgil also seems to use the word in the same sense,

1 Georg. (rentes Semina vidi equidem multos medicare se-
Et nitro prius, & nigra perfundere amurca.

I have seen many would anoint their grain
With Nitre first, then lees of oil would spread.

This kind of good Husbandry he expresseth before when he saith,

Arida tantum
Ne saturare fimo pingui pudeat sola; neve Effetos cinerem immundum jactare per (agros.

Nor with rich dung spare hungry grounds to feed,
And unclean ashes on poor Champains spread.

As Mr. Ogilby well renders them. Now these latter verses manifestly prove that salts enrich the soil, and therefore it seems that Nitre in the former verses must signify either salt extracted from ashes, or ashes themselves wherein the salts lye. And to the same purpose are those verses in the same Book.

To
To burn dry stubble, on the barren fields,
In crackling flames, oft handsome profit yields.

From which burning nothing but salt is produced, whose nature 'tis to destroy the weeds, which being a long time and strongly rooted in the earth, would draw away from the new sowed and tender corn all the nourishment, and thereby render the ground barren, and the seed unprofitable, besides the use of ashes and salt, to destroy worms, which otherwise might eat up the grain. But the coldness of Nitre, as my Lord Bacon affirms, is an enemy to all sorts of grain; besides learned Cæsalpin, lib. 3. cap. 23. de metall. Calls the ashes of Kali a kind of Nitre. Add hereunto, that in the Western parts of England, these Algas whereof Kalp or Kelp is made, serve the Husbandmen to stercorate their land, which is practised also by the inhabitants of the Mediterranean, as Ferantes Imperatus relates. And though Nitre may be extracted from sea-water, and some Vegetables, yet 'twould run almost all of it into Sandover, being put into the Furnaces.
Chap. 7. Salt of Lime. 'Tis not here used; that which is sometimes found on old walls, and hence called Paretonium, is much stronger than the Ordinary salt of lime, a large piece whereof I have amongst my Cimelia, very Diaphanous, very like in figure to Alume, and of a strong Saline tast. Imperatus commends the Lime made of the Pisces crustacei and testacei, such are Oysters and Crabs or Lobsters, to extract a good salt for glass. And upon experience I have found that a lime of them (used in Holland by the plasterers) affords plenty of a strong salt: But this salt, though it make a very white glass, yet 'twill not be so transparent as that of Kali, and most thereof will run in the pots into Sandever.

Chap. 8. Frit, seems to be derived from Frittare to Fry. For 'tis nothing else but salt or ashes fryed or baked together with sand, and so the English call the whole quantity baked at a time in the Calcar a batch. And secondly, the Frit melted runs into lumps like Fritters, call'd in Italian Frittelle or little Frits. 'Twas by some anciently call'd Hammonitrum, and by others more agreeable
272 Observations on the first Book.

greeable to Etymologie Ammonitrum, compounded of &\nu\nu\u03b4\u03b1\u03c7\u03c9, sand, and \upsilon\tau\omicron\nu\omicron\omicron, Nitre. For so Pliny, lib. 36. cap. 26. Fine sand from the Vulturnian sea is mixt with the weight or measure of three parts of Nitre, and being melted 'tis carried to other Furnaces. There a mass is made which is call'd Ammonitrum, and this being reboil'd makes pure and White glass; and Cæsalp. more expressly, Ex arena & nitro fit massa quam Plin. Hammonitrum appellat, hodie Fritta dicitur, of sand and Nitre a mass is made which Pliny calls Hammonitrum, but at this day 'tis called Frit.

This making of Frit serves to mix and incorporate the materials well together, and to evaporate whatsoever superfluous Humidity they contain in them. Green-glass Frit compounded of grosser materials requires 10 or 12 hours baking more or less, according to the goodness, softness of the sand, and ashes.

We have three sorts of Frits. First of Crystall for Crystall metall made with salt of Powlerine and sand. The second and Ordinary Frit is made of the bare ashes of Powlerine or Batillia without extracting the salt from them, this makes ordinary white or Crystalline metall. Thirdly, Frit for Green-glasses,
Observations on the first Book. 273

glasses, made of common ashes without any preparation of them, or else of Cobbets ground to a fine powder, and a hard sand fetched from Wooll-wich in Kent.

The materials must be finely powdered, washed and served, and then mixed, and equally compounded together, and then the fire of the calcare will exactly mix them in the smallest particles and minutest atoms. For otherwise the Sand and Salt; will in the melting pot easily separate the one from the other, which they are apt enough to do were they not often stirred with the Rake.

Pounded in stone Mortars. This following way now in use is much more expedite, they now grind their ashes which is in hard lumps, their Manganese, Zaffar, Collets calcined, Clay and Salts, in a Horse-Mill, the stone whereof is 9 or 10 inches thick, and 7 or 8 foot Diameter, and turns on a floor, where the materials to be ground are put, and are both of hard Marble. This grinding dispatcheth more in one day than 20 men can do in a Mortar.

We use no casting of water on the Frit, nor wetting it with Lees, but work it off in the pot.
Chap. 9. The quantity of the Manganese, &c. the reason whereof is because the colours to be put in are of various goodness, some higher, and others lighter, especially the difference of Manganese and Zaffer, is so great, that some thereof is good for little, other very rich, some of a middle nature, and to know their difference in goodness, there's no way found out but tryall in the furnace, neither in our Glass houses, nor in pottery where they have very great use of both. Besides, the metals of the same materials, and of the same preparation, change the quantity of the colours, in several pots. Wherefore the Conciator always puts in all his colours, not by weight, nor measure, but by little and little at a time, and then at each time mixeth them well with the metall, and taketh out a proof, and by his eye alone judgeth whether the colour be high enough, and when too low adds more of them till he attain the desired colour.

The furnace must have dry & strong wood. Our Author every where commends Oak, for that
that makes a strong and durable fire with a good flame. Ferant. Imper. l. 14. c. 16. saith, that the Glass-men in working-glass, because they would have a substantial and gallant rather than a great flame, use the trunks of ash, which ascending directly, and straight, comes to the Vortex of the furnace, and communicates it's force to the pots within. Ash indeed affords a most pleasant fire, but soon decays, and therefore unless a continual supply be made, the metall will not be kept melted, nor fit to work. Camer. in Horto deservedly commends Juniper as a most lasting and strong, and sweet fire, could plenty thereof be had. I know not therefore what Pliny means, who l. 36. c. 24. saith, levibus vitrum aridisque lignis coquitur. Glass is boil'd with light and dry wood. Nor why Plutarch should say, that Tamarisk is fittest to form Glass: for certainly so great a fire as Glass requires cannot be made with such woods. One effect of the fire mentioned by the Arabian physicians, and from them by others, I may not omit, viz. the burning of Glass mixt with sponge, which being calcin'd they commend to break the stone in the Kydneys and Bladder, and for outwards Ulcers, But the ways to burn it, taught by them, are wholly unfit, and 'tis most certain that the
Observations on the first Book.

longest and strongest fires, will onely keep it in fusion, but never reduce it to a powder.

Casts forth Sandever, sal Alkali, call’d by the French, Suin de verre, that is the fat of Glass, and by contraction in English Sandever. ’Tis a very white salt, and inclining nearest to a nitrous taste, and easily dissolveth in the air, or any moist place. Our Conciators never cast the metall into water, to separate this salt from it, but take it out with a ladle, for it swims on the top of the metall. This must be separated and all scummed off, or else ’twill make the Glass unfit for working, very brittle, and no way plyable. The best metall will yield in a pot of two hundred weight a quarter or half a hundred of Sandever. The weaker the salt or ashes are the greater quantity of Sandever they yield, some four or five parts more than others do. For green glasses when the ashes are bad they are compell’d to fill the pot four or five times with more fresh ashes, by reason of the quantity of Sandever that is in them, before the pot will be filled with metall. Whilest any of it remains in the pot, they may not cast in any cold water to hinder the boylinge over of the metall, for if they should, the furnace and pots would be blown up.
Observations on the first Book. 277

up together. Sandever serveth to make metalls run, and a little thereof put into Antimonv and Salt-peter, for making Crocus Metallo-
rum, encreaseth the quantity of the Crocus, and 'twill therewith separate better from the Scoria. 'Tis sold into France, and there used to powder their meat, and to eat, instead of common salt; a solution hereof bestowed on garden-
walks destroys both weeds and vermin.

Necks of the Glass, are also call'd Col-
lets, which they always break off their iron rods (whereunto they stick) before they take new metall out of the pot, and these they throw into a place ordained for that purpose, which they grind, and put to the metall, and make thereof the purest green Glass onely, though the product of the finest Virgin metall.

Chap. 10. C Alcine it well. The Glass must continue twenty four hours or more, nay, two or three days in a strong fire, the longer the better, for this refines the Glass, and takes away all Blebs and Blislers from it.
Chap. 11. Tartrar in great lumps. Because this comes from the strongest wines, and hath suffered no damage by salt water, or any other, which dissolve it into small pieces, and draw from it some of its strength. They calcine it in a place made for the purpose near the Lect of the furnace, on either side of the utmost working holes, in six hours time, and that to whiteness, too, which worketh all the effects in Glass with us, better than a lower calcination doth.

Chap. 12. Zaffcr and Manganese, have no other preparation here than bare graining them in the mill to a fine powder, and serving them in the same serces wherewith they serve their Polverine, and other materials. What Zaffcr is I cannot find in any Author, few there are that mention it. Cardan. 1. 5. de subtil. calls it an earth. Est alia etiam terra quae sic vitrum tingit Caerulei coloris quam Zapheram quidam appellant. There's another earth which colours Glass Blew, some call it Zaffcr. But since him Oæsalpinus, 1. 2. c. 55. reckons it among stones. Alius est lapis vitrum tingens colore coeruleo et si plusculum addatur inficit nigredine, Zafferam vocant. Hic ex cinereo
Observations on the first Book. 279
tendit ad purpureum ponderotus & friabilis est; per se non funditur, sed cum vitro fluat aquæ modo. There's another stone colouring Glass Blew, and too much colours it Black, they call it Zaffer. It enclines from an Ash to a Purple colour, 'tis heavy and brittle, it melts not of it's self, but with Glass it runs like water. Aldrovand. in Musæo follows both, and in one place calls it an earth, in another a stone. Ferant. Imperat. l. 26. c. 8. likens it to the Load-stone and Manganese. But 'tis not an earth, for it mixeth not with water, nor will it be compounded with it. Neither is there any stone so brittle as Zaffer, for with your fingers you may easily crumble it into a sandy gritty substance, which appears so to the teeth. And certainly were it either of these or any natural colour it could not but have been taken notice of by some writer on these subjects, being a thing so commonly used, and so much thereof spent in Glass and Pottery. It scapt the knowledge of the diligent Agricola, who no where mentions it, and Jul. Scaliger who saw a Book concerning Glass, replies nothing to Cardan concerning it. So that it seems to me to be an artificial thing of late invention, and made by some metal-men in Germanie (from whence all of it comes) and kept
kept by them as a secret. And if I might conjecture at it, I should think that 'twere a composition of Brass and Sand, and perhaps some Lapis Calaminaris added thereunto. The Blew colour it gives, induceth me to think, that 'tis from Brass, as the colour of Manganese is from Iron: for certainly nothing can give a tincture to Glass, but what is metalline, and all mettals do give a tincture thereunto. Lapis Lazuli a very hard stone loseth it's colour in the fire, and so do other preitious stones. 'Tis true, Antimony gives Glass a colour, but 'tis by reason of it's Metalline part the Regulus onely. Much less will any sort of earths bear the strong heat of their furnaces. For though Scots-ochre and India-red, may be both calcined into good colours for the uses they are emploied for, yet in the Glass furnaces they wholly lose them. It remains then that nothing but what's metalline must produce this colour, and if metalline what can it else be but Brass? For though silver be said to afford this colour, yet that proceeds from the allay of Copper wherewith 'tis mixed. For purely thrice refined Silver gives not tincture at all to the parting water. A second ingredient into Zaffer is sand, your tongue and teeth may easily discover it, but if you put it into Aqua fortis you shall...
Observations on the first Book. 281

shall manifestly see some white and transparent gravel, very like the powder of our transparent pebbles, or perhaps the forementioned quocoli described by Imperatus, and some other like our common sand, of a Brownish colour, which will easily vitrifie. And thirdly, the reason I suppose that Lapis Calaminaris may be admixt therewith, is, because neither Aqua-fortis nor Spirit of Vitriol, poured on the Zaffer, have any operation sensible thereupon, either as to raising bubbles, solution, or tincture. Both which experiments I tryed with ordinary Aqua-fortis and Spirit of Vitriol, and could not perceive the least bubble arise, nor smallest motion of these liquours, nor any tincture in either, nor hissing noise, which hapneth in the solution of metalline bodies. But that the Lapis Calaminaris hinders the solution & consequences thereof will be manifest by an experiment we shall presently produce. Besides this ebullition may be hindered by the admixture of some Rosin or Gum, on which these liquours have no effect. With what preparation of Brass or Copper, this is made, I cannot determine, whether from the Ore or some preparation delivered by Authors, or what other way, a few experiments might detect this secret, and untie this knot, whereunto I shall leave the Reader. Lastly, whosoever shall con-
Observations on the first Book.

Consider the weight, value, and colour, now changed from the Purplish of the Authors to a Brown (for so is all that I have seen) will not with much difficulty be persuad'd to be of my conceit. 'Tis call'd Zaffer from the Saphyre-stone, with whom it communicates in it's Blew colour.

Chap. 13. Manganeze (so call'd from it's likeness in colour and weight to the Magnes or Load-stone) is the most universal material used in Glass, not onely to purge off the natural Greenish Blewish colour so call'd by Virgil 4. Georg.

Eam circum Milesia vellera Nymphæ, Carpebant hyali saturo fucata colore.

Whereon the Commentator,
Vitreo viridi Nymphis apto.

which is in all Glass, and therefore may be call'd the Soap thereof; but also to tinge it, which it doth with a Red, Black, Purple or Murray colour; nay'tis the most universal ingredient into all colours, as this present work demonstrateth. Concerning it Cæs. 1. 2. c. 55, more largely and very well in these words. Hoc genus Magnetis hodie vulgo Manganeze vocatur,
Observations on the first Book. 283
catur, ab Alberto Magnesia, addi soler ad confectionem vitri, quoniam in se liquorem vitri quoque ut magnes ferrum trahere creditur. Lapis est niger, Magneti similis, quo utuntur vitrearii. Si enim medicum ejus vitro admisceatur, illud purget ab alienis coloribus, & clarius reddit, si vero amplius, colore purpureo. Affertur ex Germania, foditur quoque in Italia in montibus Viterbii & alibi. Meminit & Plin. pseudomagnetis. Inquit enim in Cantabria non ille magnes verus caute continua sed sparsa, nescio an vitro fundendo perinde utilis, nondum enim expertus est quisquam; ferri inquit inficit aciem ut Magnes. This kind of Load-stone is now call'd Manganese, by Albertus Magnesia, 'tis added in the making of Glass, because 'tis thought that it draws into it self the liquour of Glass as the Load-stone doth Iron. 'Tis a Blackstone like the Load-stone, the Glass-men use it. For if a little thereof be mixed therewith, it purgeth it from improper colours, and makes it clearer, but if too much it colours it Purple. 'Tis brought from Germanie, 'tis also dug in Italy in the mountains of Viterbium and elsewhere. Pliny also mentions the Pseudo-magnes. He saith in Cantabria not the true Load-stone in a conti-
Observations on the first Book.
continual, but scattered rock, I know not whe-
ther it be as good to run-glass, for no body yet
bath made tryal of it, it colours (saith he) Iron
as the Load-stone doth. Cardan. 1. 5. de sub-
tilitat. calls it Syderea (upon what ground I
know not) and mistakes the colour, putting Blew
for Red. Whereunto Scal. exerc. 104. 23, re-
plies, Manganese is unknown to me, yet in a
Manuscript of blowing Glas belonging to Pan-
theus a Venetian 'twas written, that Glas
was coloured Purple therewith. Believe the
Author as you please. I remember when I was
a Boy and lived at Ladroni, there was dug up
at the Solodonian-mountains (if I mistake
not) I know not what, which they said was car-
rried to Venice, wherewith Glass was refined to
that whiteness, and purity that it kept the name
of Crystalline. I seem to remember the colour
was that of Iron. Secundus my Master taught
me that Glass by the admixture of an Iron co-
lor grew white by reason of the strange Co-
hesion of both substances, whose parts being
compounded, the colours also entred one into
another, and that the Manganese of an Iron
nature did exhale, being impatient of the fire,
and carried away with it the foulness of the
Glass, no otherwise than Lees wherewith linnen
is cleansed. A judgement not unlike this opi-
Observations on the first Book. 285

Now I find in Arist., where he sheweth the force of Origanum to purge wine. But this Iron substance exhales not, if it be mixed with metals, because then 'tis baked with less fire or a less time. And this is all we have delivered concerning this Manganese. Now in these discourses, two things are observable, the attraction, and purgation. As for the former, attraction of the liquour of Glass, there's no ground for it, no more than the bare name imports, which was imposed ex placito: For if you apply never so great a quantity of Manganese to the smallest particle of broken or melted Glass, it stirs it not. And then if they mean by the liquour of Glass the Sandever part thereof, 'tis certain the greenish colour remains in the metal after that is wholly scummed off, and that Manganese then put in refines it. But if they mean by liquour of Glass onely liquid Glass, then 'tis onely gratis dictum, no argument, no experiment being brought to prove it. As for that of purifying 'tis as manifest as the attraction is obscure. Though the modus be very doubtful, Scaliger and his Master Secundus think 'tis by the way of exhalation, and perhaps, Plin. & Cæsalp. mean by their attraction, this purgation, but then they tell us not what becomes of them both. They must be separated from the metal by
precipitation or exhalation, but the former cannot be, for then the metall being stir’d twould return to it’s former colour, or twould be found in the bottom of the pot in the form of powder, as in other precipitations ’tis constantly usual.

And the exhalation is as incredible since there appears no loss of weight after this refining, besides how can the fixed bodies of Manganese arise in exhalation being inviscated with the tenacious substance of Glass? and what strange choice can there be supposed in the Manganese, that it should call out the Greener part onely of the metall to be carried away with it into the air, and in insensible vapors too? The reason seems to me to be onely a change in the figure and minutest parts of the metall, for the fire making the Manganese run, mixeth it with the smallest atoms of the metall throughout, which by boyling, and various agitation and revolution of them frames those atomical figures which are apt to reflect most of the light which falls upon it, and is the same we call White.

Multitude of instances might be given to illustrate this doctrine of the production of colours by mere transmutation of parts, but we shall content ourselves with those onely which by admixture of colourate bodies become white.

Take then Terebinthine which is of a yellowish
Observations on the first Book. 287

lowish colour, or Oleum Capevæ of a blackish colour, or tinge oil of Turpentine with Verdegreas (in which 'twill easily dissolve) into as full a Green as the natural colour of Glass, and shake either of these very well together, with the yolks of Eggs, and they all make a very clear and white colour. Or else take a strong lixivium of the Soap-boilers, and mix it by agitation with the Greenish oyl of Elder, and you shall therewith make that medicine Physicians call Lac. Virginis, you may do the same with any other oyl, and the said Lee. Here you have the colour of a Yellowish Red-lee destroy the green of the Oyl. Again Oyl of Tartar poured on the green water made with the solution of the Pyrites in rain water, gives a white colour, nay the said Oyl poured on Green or Blew Copperas dissolved in common water, effects the like, though the colour will not be altogether so white as in the former, unless you add a great quantity of oyl of Tartar, which instances sufficiently refute the way of exhalation, and manifestly convince that this purging of Glass, is wrought onely by a various texture, and position of the parts of the metall, made by this new accession of Manganese. Nay, what other reason can be assigned, but this change, why Salt and Sand both most white, should pro-
Once a coloured metal? or why Zaffer and Manganese should produce a Black?

That Manganese consists of much Iron seems beyond contradiction, which may be evinced by these experiments. I poured Aqua-fortis upon some powder of it, and in a narrow mouth'd Glass, the water rose up in great bubles, and immediately boiled over the Glass, and in a Glass, with a wider mouth it rose less, and a strong, and most piercing fume there from, offended much my Nose-thrils. And Spirit of Vitriol poured on it boil'd a little, but sparkled more, the glass became so hot that I could not hold it in my hand, and that which seems peculiar to the Manganese, fair water poured thereon encrased the decaying heat very much. The tincture of this stone was of a deep claret colour. All which agree throughout with the same Spirits poured on Iron; and certainly the colours of the Manganese, come from the Iron that it contains. Red is common to them both, and a Purple is but a deeper Red with an eye of Blew, and the same colour some preparations of Crocus Martis have, and as black is made with Zaffer and Manganese, so rich Blacks in silks are made of slip, that is the powder which the Shear-grinders grind from shears and other edge tools mixed with Sand from the Grind-stone, and...
Observations on the first Book.

and doubtless would be of use in the colour pots of the furnace did they know it, and would they use it. Secondly, this Manganese makes the metall rise much, and boil as all Iron or Steel alone, or Crocus Martis, or any other preparation, or composition thereof, which quality is also common to Copper, Brass and Lead. Observe here, that wheresoever any of these are put into the pot our Author commands that it be done leisurely and by little and little, and that some vacuity be left in the pot, for fear you lose your metall which will run into the fire and ashes, and thereby you lose the time and charge, for all this commonly goes together with him.

Our Author here commends Manganese of Piemont, for the best in the world, and therefore wheresoever he mentions the one, he subjoyns the other. But some few years since, the industry of our nation hath found in our own country at Mendip-hills (famous for Lead) in Somersetshire, as good as any used at Moran. Wherever the Lead-Ore-Men find it, they certainly conclude that Lead-Ore lies under it. They call it Pottern-Ore, because the Potters spend such great quantities of it, this being the onely materiall wherewith they colour their ware Black, as they do Blew with Zaffer. They

V
238 Observations on the first Book.

dence a coloured metal? or why Zaffer and Manganese should produce a Black?

That Manganese consists of much Iron seems beyond contradiction, which may be evinced by these experiments. I poured Aqua-fortis upon some powder of it, and in a narrow mouth’d Glass, the water rose up in great bubbles, and immediately boiled over the Glass, and in a Glass, with a wider mouth it rose less, and a strong, and most piercing fume there from, offended much my Nose-thrills. And Spirit of Vitriol poured on it boil’d a little, but sparkled more, the glass became so hot that I could not hold it in my hand, and that which seems peculiar to the Manganese, fair water poured thereon encrease the decaying heat very much. The tincture of this stone was of a deep claret colour. All which agree throughout with the same Spirits poured on Iron; and certainly the colours of the Manganese, come from the Iron that it contains. Red is common to them both, and a Purple is but a deeper Red with an eye of Blew, and the same colour some preparations of Crocus Martis have, and as black is made with Zaffer and Manganese, so rich Blacks in silks are made of slip, that is the powder which the Shears from Shears and other edge tools mixed with Sand from the Grind-stone, and
Observations on the first Book: 284

and doubtless would be of use in the colour pots of the furnace did they know it, and would they use it. Secondly, this Manganese makes the metall rise much, and boil as all Iron or Steel alone, or Crocus Martis, or any other preparation, or composition thereof, which quality is also common to Copper, Brass and Lead. Observe here, that wheresoever any of these are put into the pot our Author commands that it be done leisurely and by little and little, and that some vacuity be left in the pot, for fear you lose your metall which will run into the fire and ashes, and thereby you lose the time and charge, for all this commonly goes together with him.

Our Author here commends Manganese of Piemont, for the best in the world, and therefore wheresoever he mentions the one, he subjoyns the other. But some few years since, the industry of our nation hath found in our own country at Mendip-hills (famous for Lead) in Somerset-shire, as good as any used at Moran. Wherever the Lead-Ore-Men find it, they certainly conclude that Lead-Ore lies under it. They call it Pottern-Ore, because the Potters spend such great quantities of it, this being the only material with wherewith they colour their ware Black, as they do Blew with Zaffer. They count
Observations on the first Book.

count that the best, which hath no glittering sparkles in it, and is of a Blackish colour, but powdered of a dark Lead colour, 'tis very hard ponderous, the deeper the colour, the deeper it colours the metal in the Furnace, 'tis to be put into the melting pot together with the Fritt.

Chap. 14. FERRERETO of Spain, commonly call'd æs ustum, or burnt Brass, and 'tis made Latin, by Coesalp. 1. 3. c. 5. where he thus saith, Optimum æs ustum conficiens batur in Ægypti Memphide deinde in Cypro, cujus notæ sunt, ut sit rubrum & attritum colorem Cinnabaris imitetur, nam nigrum, plusquam decent exustum eft. Hodie in Hispania conficitur, appellant autem Ferrettum, sed nigrum eft, insicrit nigredine, idæo utuntur ad capillum denigrandum. The best burnt Brass was made at Memphi in Egypt, afterwards in Cyprus, the marks whereof are that it be Red, and that by bruising it imitate the colour of Cinnaber, for that which is black is too much burnt. 'Tis now made in Spain, they call it Ferrettum, but 'tis Black and colours Black, therefore they use to colour therewith their hairs Black. But if it be calcin'd to a mediocrity it appears Red, & 'tis
Observations on the first Book.  291

of the same colour when powdered; and hence it seems to have it’s name Ferretum à ferreo colore, for Crocus Martis appeareth to the eye Red, though much lighter than Ferretto doth. By the former discours of Cæsalp that some Countries afforded better Ferretto than others, as Castile Soap, and Venice Glasses are the best, but we find no such difference in the several climates, that we need fetch any thereof from Spain.

The two most eminent and singular colours, both in themselves, and in relation to animals, and to this Art of Glass, are Blew and Green; in themselves, as partaking much of light, as is seen in the Triangular-Glasses, and they are also most delightful and agreeable to the sight, and eyes of animals as neither widening nor contracting the Pupil too much, both which are dolorous and offensive; and in the Art of Glass, in Pastes, Enamels, Glass of Lead by reason of their great conformity and neereness to many sort of gems, challenge a great share of use, besides the many gradations of them used simply of themselves, or else blended and mixed one with the other. Blew is a simple colour in all Arts conversant about it, but Green in the curious Art of dying is a compounded co-

V 2 lour
Observations on the first Book.

Iour of Blew the Ground, and Yellow super-induce, or contrary-wise wrought. But in other Arts this colour is simple, and both arise from the same material Copper or Brass by various ordering and preparing them. 'Tis a strange and great mystery to see how small and undiscernable a nicety (though the same materials be used) makes the one and the other colour, as is daily discovered by the refiners in making their Verditer, who sometimes with the same materials, and quantities of them for their Aqua-fortis, and with the same Copper-Plates, and Whiting make a very fair Blew Verditer, otherwhiles a fairer or more dirty-green. Whereof they can assign no reason, nor can they hit on a certain rule to make constantly their Verditer of a fair Blew, to their great disprofit, the Blew being of manifold greater value than the Green. Now although the genuine and natural colour of Brass and Copper, is the true Sea green, mixed of both colours, yet the former inclines more to a Blew than the latter, and the dissolvents have a great share in this business. For Verdigreas made of Copper-plates buried in the earth with Grapes, makes a Green, but Copperas made with Copper, and the liquor of the Pyrites dissolved with rain water, yields a
Observations on the first Book.

Blew in Dantzick and Hungarian, and Roman Vitriol, the onely difference of these proceeding from the resolution of the materials into finer & minuter Particles, and various texture of the Atomical parts of the materials dissolved. Now the reason why Brass makes a better Blew than Copper, seems to be this, that the Lapis Calaminaris the onely thing that differenceth them, takes in, and incorporates with it's self that acidity which naturally Copper contains, which as it appears in the making of Verdigreas turns it to a Green, being exalted by the acidity of the Grapes. And this seems also to be the cause, why French-wine-grapes, which have more acidity in them than Spanish-wine-grapes have (though the climate of Spain be more suitable than that of France) are fittest to work this effect. The force also of Vitriolate juyces may be seen in our English Copperas, and Vitriol of Mars, made of Spirit of Vitriol and Steel, both which change the natural Yellowish colour of Iron into a Green, and Lapis Armenus a Blew stone ground with Vineger, or the tincture thereof drawn. The effect of Calaminaris in drinking in the acidity of the Vitriol do the same, an ingredient into Aqua-fortis is clearly manifested, by a pretty and lucid experiment.
Observations on the first Book.

riment, was once shewed me by my neighbour a Refiner, who bought some Copper-plates to draw down his silver from Aqua-fortis where-in 'twas dissolved, but these Copper-plates would not wholly precipitate the said silver, but left ten pound thereof: in thirty remaining unprecipitated in the water. The reason whereof was found to be, because the Copper for those plates had been melted in a pot, wherein Brass before had suffered Fusion. The Copper-smith, hereupon remelted the said plates in new pots, and with a strong fire, burnt off (as they usually do) the flours of the Lapis Calaminaris, which are volatil and fly about the work-house, colouring the Cloaths, hairs, and Beards of the Work-men, as white as those of Meal-men, or Millers. Now when these flours had been well separated, and the Copper-plates freed totally from them, they drew down the silver wholly from the Aqua-fortis. Now in this experiment the Lapis Calaminaris, imbied part of the acidity from the Copperas, and so the Plates being less corroded, and consequently too little thereof received into the parting water, left room for the silver to remain, and to be supported by the said water which is the reason of all precipitation, for the new advenient metall coming into the place of the
Observations on the first Book. 295

the silver, forceth it to descend upon the Boule and Plates in the form of a white powder. But that this effect followed from the imbibition of the acidity from the Aqua-fortis seems manifest, because Aqua-fortis-vineger, or it's Spirit, or any other acid juice, poured thereon becomes more sweet, and heavy, as they do with Coral, Crabs-eyes, (as they are falsely call'd) the shells of fishes or Lapis Lyncis, and whitening therewith & the water from the Copper-plates Verditer is made, likewise do. And hence it proceeded too that the water made with these Plates, acquired the most singular sky-colour the said Refiner had ever seen. And to this purpose I remember, that from Brass dissolved in common Aqua-fortis, with an addition of Crabs-eyes, a most fair sky-colour proceeded thence.

Of all metalls Copper is the most pliable to the Hammer, drawing into wire, gives malleability to silver and gold in coins, and is of no hard solution in the fire, is soon corroded with any acid Spirits or Salts, and without great difficulty is resolved into a powder with the fire. Five preparations or reduction to powder our Author gives, First, a calcination of Copper, c. 14. of Brass, c. 21. with Sulphur, then
Observations on the first Book.

Then with Vitriol, c. 15. Thirdly, a simple calcination of Brass by fire, c. 20. of Scales of Brass, c. 24. Fourthly, Scales thrice calcin'd, c. 25, 28. Fifthly, the making of Vitriol of Venus, c. 31, 132, 133. All which are so well known to the meanest Chymists I shall need to say little of them, especially having given so large an account, how the two prime colours, Blew, and Green are thence reduced. But above all these preparations, that of Vitriol of Copper carries the preheminence, and next to that being prepared the same way with it, the calcination with Sulphur, and especially with Sulphur vivum in a clear and strong fire makes a better colour than any of the other calcinations mentioned by our Author. For though Originally Brimstone and Copperas are made of the same Marcasite, and produce Spirits undistinguishable each from other, yet Sulphur sooner and better penetrateth into the body of the metall, being more vehemently driven in by the most acute and sharp points of the flame, and so consequently divide more subtly the smallest particles thereof. Besides the flame dissipateth and carries off the Spirit of the Sulphur, which of its own nature is apt to blacken, and make all colours more dirty, For
Observations on the first Book. 297
as 'tis well known Copperas with gals or any other astringent vegetable make Ink, and the Black for dyers. But if you list to try Vitriol, you must not use English Copperas made with Iron, but that which is made with Copper, Because experience teacheth the Refiners that Aqua-fortis, made with it will carry its foulness through all their mediate solutions even to the Verditer its self, which 'twill make infallibly of a dirty Green colour. Wherefore they make their Aqua-fortis of Dantzick Copperas onely.

Whosoever then would extract a good colour with Aqua-fortis (which may our Author useth not though he doth in making Crocus Martis) should make it with Salt-peter and Alume instead of Vitriol as 'tis hereafter made for Calcidonies, chap. 38. or with Hungarian or Roman Vitriol especially the last which makes the strongest water, being most impregnated with Copper, and coming nearest to Vitriol of Venus, for with these waters rise some small atoms of Copper (as 'tis manifest by holding a knife over the fumes of such Aqua-fortis boyling) which will colour it of a perfect Copper colour. And if you dissolve in this Aqua-fortis the best Copper, and then pre-
precipitate it with speltar (which I have sometimes done with the refiners double water impregnated with Copper) you shall have a most excellent Blew, which may be of good use for the colouring of Glass; for I doubt not but the strong fire of the furnaces will wholly dissipate the speltar being of a Sulphurous nature, or convert it into Glass, for upon the dissolution thereof with Aqua-fortis it shooteth into Green Crystals, however the Copper will remain to give it's tincture to the Glass, and that this way of precipitation is much better than by drawing of the Spirit with heat 'tis apparent by this, that the finer and purer parts of the Copper rise with the water as in the experiment of the Knife, and by many others to be met with in the writings of the Chymists. One experiment more I shall add to extract the tincture from Copper. I took Copper calcin'd and Verdigreas of each an ounce and fill'd two Glass bottles with the juice and leaves of garden Scurvigrass, which abounds in volatile Salt, and closed these Glasses well, and first for a month, set them in a Sellar, and afterwards upon Leads in the Sun, during the Summer moneths, then I strained the liquor per chartam empotreticam, and had from the former a fair Skie, from the latter a pure Sea Green.
Observations on the first Book. 299

Green. And this I the rather relate, because I have not met with any experiment in this nature with volatile Salts, and 'tis very probable that other plants full of the same Salt, especially having some clammy juice in them, such as Onions, Garlick, Leeks, and Molyes have, might shew some rare effect upon Copper, for their leaves have either a deep Green, or else a Green mixt with Blew. The whole tribe of Acids also are dissolvents of Copper, and all sorts of fixed salts, all which have acidity in them. And no doubt great variety might be met withall in diversity of menstruaums, and processes of extracting these tinctures.

Our Author c. 20. tells you Brass is made of Copper and Lapis Calaminaris, I shall here deliver the process since I find it no where fully delivered, Lapis Calaminaris is found in Sommersetshire, and the North of Wales, and though some of it hath been brought from Dantzick, yet 'tis not of the same goodness with ours of England. This stone before used must have the following preparation. It must be first calcin'd in a furnace like the Calcar with a small hole on one side to put fire in, which may be either of Coal or Wood, but Wood is best, because it maketh the greatest flame, and consequent
Observations on the first Book.

sequently the best reverberation. The time of Calcination is about five hours, in which space they often rake it about with a great Iron rake. It requireth good judgement to calcine it well; for when 'tis not sufficiently calcin'd 'twill not mix with the Copper, and when too much, 'twill make it too brittle, and in both cases gives not the true tincture to Copper. The sign of it's just calcination is, when 'tis in a white and very fine powder. Almost half of the Calamie (as the workmen call it) is wasted and flies away in flour, which sticks to the mouth of the Furnace of divers colours of little use with them, though I could easily prove these flours to be the true pompholix of the ancients, and to be used in the ointment, that hath it's denomination thence. 'Tis an excellent dryer, and applied to Gleeing Nerves, and Tendons, without pain, it soon exiccate:sh them. This powder I communicated to the eternal glory of our nation, and Anatomy, & an excellent Chirurgian, and never to be by me forgotten the incomparable Dr. Harvey, a man most curious in all natural things, who confessed he thought this to be the said Pompholix, and with most happy success frequently used it. Now when the Calamie is well calcined, they grind and serce it to a very fine powder, and therewith mix well Charcoal.
Charcoal finely ground to a powder, this mixture they put into the bottom of a pot, and upon it a Copper-plate, to wit, seven pound of this mixture, to five pound of Copper, which is their usual proportion. These pots are made of Nonsuch-clay, which must be first calcin'd if they make pots of it alone, but usually they grind their broken pots with an equal quantity of the clay, and therewith make them, which being well wrought and annealed, will commonly last 12 or 14 days.

The furnace wherein they melt their Copper and Calamie is about six or seven foot deep under ground, the earth being circularly raised by degrees from the plain of the workhouse to the hole, whereby the materials and fire are put into the furnace, which is the center of the raised earth, and in a perpendicular to the bottom, and area of the furnace. The diameter whereof at the bottom is three or four foot wide, growing gradually narrower and narrower in the form of a cone to the said hole which contains a foot in diameter, wide enough to put in and take out their pots and fire. This hole hath an Iron cover with a small hole in it, whereby they regulate their fires. At the bottom of this furnace, they have a long pipe or hollow place.
Observations on the first Book.

place by which they blow their fire with bellows. At first they make a very gentle fire, encreasing it by degrees, till they see the Copper melted down, and well mixed with the Calamic, which is usually done in the space of twelve hours; for every twelve hours, they cast their plates at five in the morning and evening; and then they take their pots out of the furnace (which are usually eight or ten in number) with a long pair of tongues, and set them in a hot place a little time till the metal grows a little cooler, yet still melted, and then pour it out of all the pots together into a mould of stone, which produces a plate of Brass three foot long, and a foot and a half wide, weighing betwixt 60 and 80 pound. The mould is made of two stones which seem to me to be of that sort, which are call'd Calcarii, for they have many small shining particles in them like Spars, which continue after long use of these stones, whose colour is thereby changed from a Gray to a reddish Copper colour, only the spots remaining. These stones have formerly been brought from Holland, but have been sometimes since found in the mountainous parts of Cornwall, and are as big as a reasonable gravestone, and of the same figure. They must be annealed some hours before they cast their plates on them, else the metall
Observations on the first Book.

Metall will fly, and besides endanger their breaking. They must have many pair of them in readiness, because after three days casting they become weary (as they call it) and must be new coated with coal and tallow. 'Tis to be observed that the mixture of the Calamie and Coal, must be always put under the Copper-plates, for then the Calamie being raised by the mix Charcoal and heat of the furnace easily penetrateth and mixeth by little and little with the Copper melted, and so both unite into one mass, making the compound call'd Brass. whereas the Calamie would most of it fly away should it be put above the Copper-plates. And though the interposition of the Copper hinder it's ascent, yet much thereof flies away and sticks to the sides of the furnace, and according to the diversity of the superior or inferior part of the furnace where 'tis found and difference in figure and colour receives various names, of Capnitis, Botrytis, Placitis, Onychitis, Ostracitis, so call'd by Plin. l. 34. c. 10. All which contain some Copper in them easily discoverable by the affusion of Aqua-fortis on them or by long lying exposed to the open air, nay, you shall see in them sometimes a Greenish Blewish colour, when they are taken out of the furnace. The increase of weight
Observations on the first Book.

Weight by the Calamie is from 38 to 40 pound in the hundred, so that 60 pound of Copper makes with Calamie 100 pound of Brass. Observe also that the fire must not be too strong, or must the pots continue too long in the furnace after fusion of the Copper lest the Calamie fly away, and that the coals lying at the bottom of the pot, and which were mixed with the Calamie are not totally turned to ashes, but oftentimes come out untouched, and unaltered, though the pots have continued red hot for many hours together, which is needful because Copper with the Calamie require longer time to be melted then Copper alone doth. As to the easie parting of the Calamie from the metall, we shall to what hath been formerly said, add this, that when they draw this Brass into Wire, at each new drawing they must anneal it else 'twill break, and yet they must not heat it to above a Cherry red, for if they do they burn of the Calamie to their great loss, which is easily done in Brass drawn into small threads.

Chap. 16, Deliver several ways of making Crocus Martis, all which and many more are delivered by Chymical Authors. They may be reduced to these
Observations on the first Book.

these heads, 1. A simple reverberation without admixture, and such I have seen made of Iron Bars wherewith some furnaces are supported and built, and the best, and deepest colour I ever saw was made this way in a furnace wherein Aqua-fortis was constantly distill’d the whole bars turning by little and little into this Crocus, and was brushed off in a considerable quantity. The second way is a calcination or reverberation with Brimstone, Salt, Urine, Vineger. Thirdly, by solution in Aqua-fortis, Aqua-regis, Spirit of Salt and Nitre, and then by exhaling the waters you shall have a very Red powder. The solution of Iron in Spirit of Vitriol, or of Sulphur make the Vitriolum Martis, not much differing from our English Copperas in goodness but onely in strength, either as to dying, or Medicines, which being calcin’d makes a Colcothar, not unlike that of common Vitriol, which though it may serve Painters for a deceitful colour, yet’twill not serve the Glass-furnaces, for all Colcothar contains in it much terristriety which would make the Glass foul and obscure, this seems to be the reason, why our Author useth not Vitriol here, as he doth before with Copper.

X

I shall
I shall say no more concerning the tincture of Mars, but that whatsoever of Acid or biting juices work upon Copper, the same have also their effect upon it. And though all the ways produce a red, yet some of those reds are lighter and more transparent, than others, and so may serve for several colours, and various admixtures with other Metalline colours, to advance or moderate them, for Crocus Martis made with Vineger complies with Greens, chap. 32, 34, 35. and in the Emerald colour of Glass of Lead, chap. 65. and for the same colour in pasts 'tis used indifferently with Verdigreas, chap. 77, 78, 79. and in Blacks, chap. 101. but for a fair Red, Crocus Martis made with Sulphur, chap. 128. but for more fair colours Crocus Martis made with Aqua-fortis, chap. 43. But so as the best colour from Brass is of Vitriol of Venus the primest and lightest colour from Iron or Steel, is that which is made with Aqua-regis, which proceeds partly from the mixture of Sal Armoniac, and partly from a finer solution of it.

And thus having past over the prime materials, and preparations for colours in Glass, the
Observations on the first Book.

the rest of the work consisting principally in the due mixture of the said colours with the circumstances, which our Author hath fully done, we shall be very brief in what follows, and shall only deliver here one preparation come to my knowledge, whilst a secret of great value, but now commonly enough known to the furnaces, and 'tis this. Take of Antimony and Salt-peter well ground and mixed, of each twelve pound, together with 200 weight of the common materials for glass wherewith this mixture of Antimony and Peter must be also well united, and then calcin'd in the calcar and made into a Frit, or which is all one make Regulus of Antimony with Crude Antimony and Peter, the manner every Chymist knows, which being mixed with the metall afford a very white Enamel, and serves with other mixtures for various colours.

Chap. 29. P Ort. 1. 6. c. 5. To colour the Blew Gemm which the common people call Aqua-marina (and our Jewellers Egmarine) a kind of Saphire. Beat burnt Brass into a most fine and impalpable powder, otherwise a courser gemm will be made thereof, and let it be mixed with Glass. The quantity cannot be determined, for they are made

X 2
Observations on the first Book.

made deeper or lighter, for one pound of metall one drachm of burnt Brass will suffice.

Chap. 32. For the Emerald colour Porta, l. 6. c. 5. thus, when you have coloured that Egmarine you shall easily turn it to an Emerald, by adding half Crocus Martis to the calcin’d Brass; to wit, if at first we put in a fourth part of Brass, we now add an eighth part of Crocus, and as much calcin’d Brass. Observe that they boil together six hours after the colours are put in the stuff, that the jewels may grow clear which became cloudy by putting in the colours. Brass is heavy, and when ‘tis mixed with the metall, every moment ’twill sink to the bottom of the pot, and make the gemm more dilute, wherefore you must very often stir it. Let the fire decrease by little and little till the furnace grow cold; let the pots be taken out of the furnace, and being broken they afford you counterfeit jewels.

Observations
Observations on the Author.

Rosichero, whereof thus, Port lib. 6. cap. 9. But the more skilful and modern Glass-men in colouring Enamels of a clear Rose-colour (the common people call it Rosachiero) take not a little pains, seeing our Ancestors made it Artificially and beautifully.

Chap. 37. Our Author adviseth you to make your Aqua-fortis, &c. your self; and good reason for it, for one pound of common Aqua-fortis upon my reiterated experience shall yield but four ounces of good Spirit, the other 12 ounces will be phlegm of Vitriol. This addition of white Arsnick in the making of Aqua-fortis, I find in the Lady Isabella Cortese printed at Venice in Italian 18 years before the publication of this work. Many are the compositions of this water, but Nitre is the principal operative ingredient.
310 Observations on the Author.

ent in them all. Most make it of Vitriol, some of English Copperas which serves for common uses, and for Bow-dies (though made of Dantzick Copperas would be better for that use) for this the refiners use finding a dirtiness from our English, some add alum instead of Vitriol, but that yields at best but a weak phlegm, Others have made essays with Sal gemm, but they found that this Salt affords no spirit, but sticking to the neck of the retort, hinders the passage of the spirits and breaks the vessels. When the red fumes are past all the spirits of Nitre are raised, and then the fire is to be extinguished, for after followeth onely the spirit of Vitriol, which hindereth the operation of the spirit of Nitre towards the solution of metals. I have often seen singular good parting water drawn by the refiners twice in 24 hours, in which time, with their fire, not much of the spirit of Vitriol could arise, which requireth commonly three days with the strongest fire can be made for the two last days to draw off both the spirit, and ponderous oyl from it, though the volatility of the Nitre in Aqua-fortis may help to raise them. One thing our Author omitteth though very necessary to be done before the Aqua-fortis be used, practised constantly by the refiners
refiners, else their waters will be foul, the manner is thus, as you have it in Beg.Tyrocin. Chym. c. 3. Take of the distil'd water and put into it a peny weight of refined silver, and dissolve it upon coals, then pour this silver water into three parts more of the unfined Aqua-fortis which will become of a milky colour, then they let it settle, and decant off the clear, this settling the refiners call the fixes; and cast it into a tub of water of 20 gallons, all which it will in a moment turn to a milk colour. I know a refiner who destilleth his Aqua-fortis out of an Iron pot, which he finds to make a stronger water, besides the great charge in pots and fire saved, you may see the way in the commentator on Beguin.

Chap. 40. You need not charge your Aqua-Regis with so much Sal Armoniac as it will dissolve, one ounce and a half to a pint is sufficient. I wonder at Beguins way of making this water, who distills the Salt-peter and Sal Armoniac together, but experience hath taught me that half the quantity of Aqua-Regis, wherein Sal Armoniac hath been dissolved, will do as much as neer double the quantity of that wherein it hath been distill'd, Aqua-Regis onely blacks silver, but X 4 'twill
'twill slowly dissolve very thin plates of Copper and Tin, as Aqua-fortis will corrode Leaf-Gold. But if you draw off the water when it hath dissolved Gold, then 'twill fall upon Silver or other metals.

Chap. 42. The ways of making Calculdonies, Jaspers and Agats seems to be the same with making marbled paper described exactly by Kirch. l. 10. de luce & umbra par. 2. c. 4. and transcribed by Schott. par. 1. l. 5. Chrom. 9. the way whereof is, that several colours are dissolved in several liquors proper to dissolve them, and are such as will not readily or not all mix one with another, when put into water, before they are cast upon the paper to receive this variety of colours. And so in like manner variety of materials being mixed together, and such as will not incorporate each with other, must needs give various and distinct colours to the metal. Many experiments might be given of tinged liquors, that put into the same Glass, would keep their distinct stations and colours, nay though the liquors were agitated and confounded, they would each return to their proper place and stations. In the preparation of these Calculdonies, I shall observe first, that all the colouring
Observations on the Author. 313
colouring materials, though not all their prepa-
\[\text{rations are used in each of the three ways, viz. Zaffer, Manganese, Silver, Steel, Smalts and Lead. Secondly, the greater variety of ingredients, makes the better Calcidony, for the first is more simple than the second, and the second than the third, and our Author com-
mends the last before the second, and that before the first. Thirdly, that some ingredients there are in each of them which contribute no co-
\]lour at all to the metall, such are Tartar, Scot, Sal Armoniac, Mercury. Fourthly, that some of them are of an unctuous na-
ture, as Lead, Scot, Tartar and Smalts, which may hinder the union of the materials one with another, which appears by this, that they do part one from another, and therefore the metall being taken when it begins to grow cold, will then shew some waves, and divers colours very fair, chap. 42. A great deal of Art there is in working the metall at a due heat, and in the manner also, and in this latter much of Art lyeth as it doth also in marbling Paper.

Porta teacheth how to colour Glass with various colours, this he found out by chance, when he was making other tryals. Calcined Tin takes away
away the perspicuous colour of Glass and variously colours it, for when 'tis sprinkled by turns on Glasses polished with the wheel, and exposed to a kindled fire, it colours them variously and renders them darker, for one part becomes stone, the other is variously coloured that 'twill seem an Opal. But you must often take them out of the fire, and fit them till you have your wish.

Here and in many other places our Author tells you that Glass may be wrought into any shape. I shall for the Readers delight set down the most curious I have met with. Card. I. 10. c. 52. de varietate saw a Cart with two Oxen which was covered with the wing of a Fly, Agric. I. 12. de re Metall, saw at Moran living Creatures, Trees and Ships, and many other famous and admirable works. Master Howel, pag. 39. saw a complete Galley, with all her Masts, Sails, Cables, Tackling, Prore, Poop, Fore-castle, Anchors, with her long Boat, all made out in Crystal Glass, as also a man in armor. Worm, had in Mulæo, little statues of Glass, both of men, and other things. The most beautiful Church of Saint Mark at Venice, adorned within with Mosaic work, representing several holy histories with fit colours,
lours, and covered in some places with Gold.

Chap. 48. P ort. 1. 6. c. 5. makes this Amethyst colour with a Drachm of Manganese to each pound of Metall.

Chap. 49. P orta for the Saphyre, adds two Drachms of Zaphar to a pound of metall, and the longer (saith he) they continue in the fire, the brighter the colour will be, you must continually mix them.

Chap. 58. D eep Reed in the original, rosso in corpo, whereof thus, Imper. 1. 4. c. 1. haver corpo dicono quelli colori che coprono e sono senza transparenza, non haver corpo dicono quelli c' hanno trasparenza. The Painters say those colours have body which are close, and without transparency, and those not to have body which have transparency.

Chap. 61. G lass of Lead, 'tis a thing unpractised by our Furnaces, and the reason is, because of the exceeding brittleness thereof. The whole Art of calcining Lead,
Lead, to glase their ware withall being the principal thing wherewith that glasing is made, is sufficiently known and practised dayly by the Potters. And could this Glass be made as tough as that of Crystalline 'twould far surpass it in the glory and beauty of it's colours, of which no man can be ignorant, that hath had any experience of this Metall. That experiment of Kircher easily to be tryed & with inconsiderable charge will evince this, thus be, l. r. de luce & umbr. par. 3. c. 5. If you heat with live coals Quick-silver congealed with the vapor of Lead in a Brass-spoon, there will soon appear to you in the melted stuff so great variety of colours, that no greater can be conceived in the world, insomuch that none of those which are call'd apparent colours may be compared with them; I remember that trying the reduction of Lead from Ceruss, by setting it over the fire, had by putting an Iron sharp pointed into it a considerable quantity of a most brittle matter, not transparent, but adorned with most beautiful colours of Blew, Green and Yellow, though the later over-ruled both the former, and some grains of Lead. I also cast some Brimstone into melted Lead which became of the fairest skie colour that ever I saw, with the intermixture of other colours with
Observations on the Author.

with the Blew, and those colours not fading but now continuing for these 12 years past, Libav. de transmut. met. l. 7. c. 20. saith, that the melters, and tryers of metals daily change Lead into Glass, and that this Glass is Black, Red, Yellow, or otherwise coloured, as the calcined Lead is handled, or as Lead is calcin'd into Lytharge, Ceruss or Minium. Quercet, in Hermet. med. defens. cap. 9. affirms he saw with his own eyes, a Ring made of Glass of Lead, which infused in wine a night was a perpetual Purgative, The like variety may be observed from Bismutum or Tin glass as Libar. Syntag. Arcan. l. 6. c. 4.

Lead returning into it's body, breaks out the bottom of the pots. Lead can hardly be so well calcin'd, but some particles thereof will remain uncalcined, which the heat of the furnace reduceth to Lead again, the same was said of Ceruss before, and the like you shall find in Minium, the highest calcination used thereof. Now the cause why it breaks out the bottom of the pots seems to be, that receiving there a new calcination, and closing with it's unctuosity, and body the pores of the pots, it hinders the passages of the fire into the metall, which impeded, converts all it's force upon the clay, whereof the pots are made, and
Observations on the Author.

by farther calcining it must necessarily make holes in them; Now that Lead doth sink into, and not as other metals continue melted on the surface of the pots 'tis manifest by the refiners tests, and Gold-smiths coples, which shew by their colour and weight, what body they have received into them, and by their remelting and reduction of the Lead. 'Tis true the tests do imbibe some Silver, and therefore they remelt them in the great heat of the Almond Furnaces, and no doubt the same happens to the coples, though the Essay Masters of the Tower strongly assert the contrary against the importers of Bullion, But the Essay Masters at Gold-smiths-hall do gain Silver from these coples by melting them down. But in this case some minute parts of Silver only get into the tests and coples by the mediation of the Lead alone, since Lead is used in both refining and Essays. But Silver alone nor other metall will at all sink into the test. Another reason of this Accident, may be that the Lead insinuating its self into the pores of the pots, and continued there in fusion, will by getting farther and farther by its weight into the bottom of the pot at last run out and then leave holes for the metall to follow.
Our Author mentions not a Jacinth from Glass of Lead, nor Glass of Tin, nor of Copper. Bapt. Port. supplies you with the first, l. 6. c. 7. in these words, To make a very Jacinth, and not much differing from the true one. Put Lead in earthen pots that are very hard in a Glass Furnace, and there let it stand some days, and thus your Lead is turned into Glass, and imitates the colour of the Jacinth, and of the second Ib. c. 9. Melt a pound of Tin in an earthen pot that will bear the fire, let it stand in the Glass furnace three or four days, then take out it, and break the vessel, and on the surface you shall find a Glass of a muddy Saffron colour, and if it stand longer in the fire 'twill become more perfect. Neither know we any more perfect in this kind of many we have tried. But you must put it into the pot well powdered, wherein you must use not onely Mortars and Mills, but the Porphyrie-stone, if you would have it lighter, dilute it by adding Glass. Another way reserved for his friends is this, let there be nine parts of calcined Tin, seven of Lead, two of Cinnaber, of Ferretto of Spain, and of Tartar one part and a half, of Lap. Hæmatitis or Blood-stone, one part, Red-ochre a quarter.
quarter, do as thou knowest. His Glass from Copper, l. 6. c. 7. is this, Dissolve Silver in a strong Aqua-fortis, then cast it into the water, Copper-plates, to which the Silver will stick, which gather and dry, then set it in the Glass furnace, and 'twill be turn'd into an Emerald in few days. I commit to you the tryal of other metals, 'tis enough for me to have searched out and shewed the way.

Chap. 72. Blew Smalts for Painters. I cannot find the composition hereof in any writer, but I have been informed by an honest workman in Glass, that 'tis made of Zaffer, and Pot-ashes calcin'd together in a furnace, made like that for Glass, and that he wrought it in Germany. But of this, and all other natural and artificial colour in a treatise designed on this subject.

Gold hinders the rising of the Metall. And so doth a little Oyl, or Tallow, thrown into a Copper of boyling Sugar, hinder it's running over into the fire, though it rise with the greatest fury.

Chap. 74. His way of colouring Crystall, teacheth the true and natural way, whereby Opals, Agats, Jaspers, Chrysolites, Cats-eyes, Marble, &c. Receive
ceive their variety of colours, they have in themselves, to wit, from exhalations of Minerals, supervening to the præexistent substance of the stone, as here the colours of Orpiment, &c. raised and driven by the heat, penetrate the body of the Crystal, and give it this variety of colour. Now if the matter of the stone being first in liquid form, and therefore capable to receive a tincture, have for it's matrix or womb such a place, whence simple exhalations proceed, the colour is single and unmixed, but if manifold, then the tincture of the stones becomes correspondent to the diversity of the colours arising therefrom. And this appears to be true, by what is frequently observed in larger transparent stones, part whereof will be coloured with their natural colour, and part void of all colour, but simply transparent like Ice. So that the whole stone may well be resembled to frozen water, to that part whereof which was first frozen an accession of colour was made, and none to the other part. Which may be seen more frequently in Amethysts than in other gems, though many other Jewels afford the like, some having in some part a colour, and some others wholly without any, or else the several parts tinged with diversity of colours.
The knowledge to imitate Emeralds, &c. There's nothing of value, but some way hath been found to sophisticate it. And since the counterfeiting of jewels with exactness, would bring more profit to the inventor, than any other adulteration whatsoever, and perhaps with no real loss to mankind, but great advance, as some Chymists affirm, and therefore not punishable by any law I know of unless in the Gold-smith who will warrant the counterfeit for true, 'tis no wonder that many means have been to this end and purpose used by pasts, doublets and foils, or colouring the bottom of them, and various other compositions, and artifices, whereof this of our Author seems the most genuine and natural. Of the fraud in Doublets, Ferant. Imper. 1. 20. c. 14. gives this relation. A jeweller of Milan sold an Emerald doublet for 9000 Duckats, and the fraud was a long time conceal'd.

The Chymists have invented a peculiar though barbarous name for these pasts, and nowhere extant but amongst themselves. They call them Amausa, so Libav. Joan Isaac, but Clauber. Amausa, which, whether derived from Musaicum (not Molaicum as Vossius
Observations on the Author

Vossius in his Glossary, proves at large) I determine not, though this Etymon be very probable. For Mosaic work was made in this manner as Hermol. Barbarus, describes it. Musivum opus quod vulgo Moseacum vocant, tessulatum lapillis variorum colorum, ex quibus arte compositis & coagmentatis omne genus imaginum redditur. Mosaic work they call that which was chequer'd with stones of divers colours, with which composed and joyn'd by art, all kinds of resemblances are made. These works were anciently made, with small pieces of various Marbles of several colours form'd in the shapes of Animals, and sometimes enchac'd with Gold, as appears by Plin. l. 36. c. 1. Senec. Epist. 86. Philander in l. 7. c. 1. Vitruvii mentions the reliques of some pavements seen by him, wherein Chequer'd Marbles no bigger than small Beans did accurately and expressly imitate in various colours, the effigies of Fishes and other things. But the use of coloured Glass succeeded the use of Marbles, and other stones. Libav. in his Syntagm. saith, the Saracenical Authors call them terra Saracenica, but he confounds these Enamels and Pastes one with the other. 'Tis true these two are very near of kin, but are distinguishable by this, that Pastes
are made of Crystall, prepared and mixed with some Glass, and so wrought into a transparency, but Enamels have the basis from calcin’d lead and tin, which gives them opacity, corporeity and solidity, by reason of the great quantity thereof mixt with the ingredients. Glauber thinks Furn. Philosop. l. 4. Pastes were found out by chance by those who reducing calcin’d bodies with a strong fire, converted them into Glass, and adds out of Isaac Hollandus, that metalls vitrified and reduc’d yield better and more noble Metalls than those which were first vitrified, to wit, Gold a tincture, silver gold, and copper silver, &c. he saith, noble Glasses might be made of Metalls, could Chrysibles be made strong enough to hold them; what he saith in many words, concerning the preparation of Crystall casting into molds and colours, contains nothing but what’s vulgar.

Chap. 76. H Artm. in praxi Chym. hath this peculiar way of preparing Crystall for making of Jewels. Dissolve, saith he, in water two ounces of purified salt of Tartar, which moisten with Beechen-ashes, make thereof balls as big as apples; Dry and burn them in a potters furnace in a covered
ed pot, for so the balls will somewhat melt, and stick one to another, let them then be finely pounded & a Lee made thereof, which congele to a salt. And in this Lee let the Crystalls be so often, and so long extinguished, till you can rub them to powder, betwixt your fingers. This being done, let some of the remaining salt be so often purified by solution, coagulation, and calcination, till no feces at all appear in the solution. Take then of purified salt of Tar-tar two parts, of the foregoing salt prepared, part one, melt them together. This will receive all the colours of the whole world, and appears like Oriental gems. Chymical Authors generally prepare Crystall this way, onely some extinguish it in Vineger instead of fair water, you may easily know the best way, by the discourse concerning the Glass drops, which is to follow, and doubtless the best way, were to extinguish it often in a strong Lee.

The making of these Pastes differs nothing from that of Glass, but that Pastes are made of Crystall prepared, as the other of Crystall metall, the colours in both are the same. And therefore Porta calls his Glass tinged with colours, by the names of Amethist, Ruby, &c.
326 Observations on the Author.

Tryal would be made with our English Diamonds, which are harder and purer than Crystal.

Chap. 77. Boeth. de Boodt, an excellent writer upon stones, writes thus of adulterating the Emerald. This may be done several ways. The best is with Crystall, Glass and Flints calcin'd, and melted, if a little quantity of Minium be added to them. So I have made good ones. He subjoyns, the making of them with burnt Brass, half the weight of Crocus Martis, boil them six hours, and let the pot cool of it's self. If they be well made they will be wholly like those that come from America. Garcias ab Horto affirms them to be made fair coloured and very large in Balaguate and Bisnager of larger fragments of glass pots, Dalechamp, thinks some green Jasper is to be added to them. Birelli, l. 8. c. 9, 10, &c. gives you the same composition with our Author, where you have many more. Another of Minium and Copper-scales, c. 5. like our Authors, c. 78. Hartm gives several ways, the first obscure, and unintelligible with Anima Lunæ, and Solis, and Crystall, with a little Sal Armoniac fixt with lime; a second with
with Minium four ounces, Crystall prepared one ounce, gold two drachms; the third with Brass calcin'd and powdered fine, mixt with a double weight of Sand for Glass, and standing four days in a very strong fire, and half a day more in a stronger fire. A fourth with his prepared Crystall mixt with a little Copper, fill herewith a pot half full, set them at a gentle fire four or five hours, then run them in a strong fire, then take away the fire, and break the pot, you shall find the stuff covered with the spume of Lead, which break, and a fair Emerald will appear, which he caused to be broke into pieces, and to be cut to his liking. This succeeds not always well, for a serene air is necessary. Therefore he prepared it in a forefold quantity, in four several pots, and so with one labour had four distinct colours one higher than another. For the first he took of Copper a scruple, for the second two scruples, for the third one drachm, for the fourth a drachm and a half, and nothing else, for otherwise they will not be transparent. The same is to be done with Jacinth and Topaz, with Crocus Martis, and with the Saphyre with Zaffer.

But in this composition Mars is wanting to give life and lustre to his Venus. Card.
328 Observations on the Author.

de var. l. x. c. 52. makes this colour of stones taken out of the river calcin'd to whiteness, and then mixed and melted with an equal quantity of Minium in a Chrysible, and this must be twice done to effect this colour, but this way is wholly insignificant.

Isaac affirms of calcin'd Copperas and the rest of the Calces, that if they be ground with salted water, and then washed with fair water, both warm, they will have a far better effect than without these washings, becoming thereby more perfect and fusible.

Seneca Epist. 91. writes that Democritus invented a way to turn stones into Emerald. And Plin. l. 37. c. 12. saith, that ways are extant in the writings of the Authors, by what means Emeralds may be coloured from Crystals, as also other precious stones, and perhaps differs not from the artifice delivered, l. 36. c. 26. de Vitro obsidiano & Myrrhino of many colours.

Chap. 81. 

Bapt. Porta thus adulterates the Topas. He mixeth to every pound of Metall a quarter of an ounce of Crocus Martis, and a little Minium, and that
Observations on the Author. 329

that it may more neatly shine, adds to each pound three ounces of Minium, but puts in the Minium after the Crocus. Boodt transcribes this, and adds this also of our Author, and then this following, powder æstustum, native Cinnaber and Crystall, and four times as much of Calcined Tin, set them a day in a fire not too strong, but kept in the same degree, for the said powder easily melts. Birelli proceeds this last way, onely changeth Cinnaber into Minium, and in the very same words, so that Boodt had this from him, as the former from Porta. Hartm. and Libav. with three ounces of Ceruss, and Crystall prepared half an ounce. The Author of quadrig. Chym. makes Salt of Tin to be the Topaz.

Chap. 82. Porta thus imitates the Chrysolite, when you have made a Topas, add a little Brass, that it may become more Green, for these two onely differ in this, that the Chrysolite shines more neatly, Claveus saw silver calcin'd two months in a Glass furnace, the twelfth part whereof became a Citriu Glass.

Chap.
Chap. 85. A Saphyre. Glauber makes this colour with silver Marcasite dissolved in Aqua-regis, and precipitated with his liquor from Flints.

Chap. 90. A Wonderful Red from Gold. The Chymists with their menstruums promise from Gold, a Gold coloured tincture, but I have heard an able Chymist offer, not an unconsiderable wager, that he would reduce the full quantity of the Gold within few grains (which sure must be lost in the process) when another eminent person of the same profession, had extracted the fullest promised yellow tincture from it. But the condition was not accepted of. Sure I am that Gold dissolved in Aqua-regis, and dropt upon the skin will colour it with a deep purple colour, lasting some days, and this solution poured on a great quantity of water will give it the very same tincture; Glauber gives it a fair Saphyre colour, being precipitated with a liquor from Flints. The tincture of silver is not a skie colour, but white, and for it you have also the undeniable Authority of Master Boyle in his Physiological Essays, pag. 60, and therefore as I have said before, the
Observations on the Author. 331
the blew must proceed from some Copper mixt with it.

Granats of Bohemia. Boeth de Boodt affirms that these Granats from Bohemia keep their colour in the fire, but almost all others not, and therefore seem the best for this use, but yet the heat of the Glass furnace consumes it, though it may persist in an ordinary fire.

Chap. 91. T'Ake Ceruls. Our Author delivers two ways of making Saccharum Saturni, the one here of Ceruls, the other of Lytharge, Chap. 123, onely in this he calcines the Saccharum, and out of it calcin'd remakes a new Saccharum. The Chymists commonly take Minium, some onely calcin'd Lead, all returns to the same purpose, but 'tis observed that Minium yields a greater quantity of Salt, and good reason, for that hath had more calcination than any of the other. All make use of distil'd vineger alone, but Beguin he substitutes in it's place Phlegm of distil'd vineger, but the commentator well passeth a deleatur upon it. Two things I shall here set down, the one that 'tis much better and less chargeable by far, to pour distil'd Vineger on new Minium at each time, and not
Observations on the Author.

on that you have used before, for the cheapness of the Minium, and the goodness and quantity of the Saccharum drawn the first time from the Minium, besides the saving a great deal of Vineger, this way will advantage the operator much in point of profit. A second thing here to be inserted is a new way, I have not met with in any Chymical writer, but invented for my own use, which doth readily and in a moment make it, and I am sure 'tis rather better than worse than the ordinary for Chirurgical uses in which I employ it. The manner of making it is this, Take very thin plates of lead, or rather that which hath been long in Glass windows, and dissolve it in Aqua-fortis (good water neer dissolves as much as it's own weight) and the dissolved Lead will soon become a Saccharum in the bottom of the Glass. I have in half an hour made a considerable quantity this way in a small glass set in sand, and at no great heat, or in a fire shovel over the fire, or in ashes. And certainly this process as more speedy so less expensive, but what this medicine will effect in glass I cannot say.

Chap. 93. T his sixth Book treats of Enamels, which seem to be so named, because 'tis used in annulis in rings, or with
Observations on the Author. 333

from the Dutch word Enameillen or the French Esmailler which comes à maille macula a spot as Minsheu, for so 'tis laid on. In Latin Encauston (that is burnt in, a word to burn) for so the Lexicographers render Eucauston Enamel, Encaustice, the art of Enamelling, Encaustes an Enamel-
er. But the Encaustum of the Ancients whereof Vitruv. l. 7. c. 9. Plin. l. 35. c. x. Mart. l. i. &c. make mention, was a thing quite different from our Enamelling. Concerning which, and the three kinds thereof, see at large Salmas. in Solin. who truly concludes his discourse, that all this Art is lost. Porta makes a Latin word, of the Italian Smalto, calling them Smalti and Libav. Smalta.

Chap. 94. White Enamel, a new way with Regulus Antimonii, you had before, Libav. & Porta make it of Calcin'd Lead one part, of calcin'd Tin two parts, and Glass the double.

Chap. 95. A Turcois, by Porta with Zaffar alone.
Chap. 97. For a Green Porta takes æstusm which the common people (saith he) call raminella, and by our Author ramina, Chap. 24. for a deeper colour, and for a lighter, the Scales which fall from the hammers, when the Brass is hammer'd Red hot.

Chap. 100. Black made by Libav. & Porta with the Purple and Blew colours, meaning thereby Manganese and Zaffer, and is the same with our Authors, the doses in all of them the same.

Chap. 103. A Red by Libav. with Crocus Martis.

Chap. 108. A Lee of Barillia and Lime. Much care is to be had of the Menstruum, this of Lime and Barillia are the best, though pot ashes with Alum, do very well also. I know an Ingenious gentleman, who this way hath made all his colours for plants, which he hath drawn to the life in a large volumne of the most beautiful flowers of all sorts in their proper and genuine colour. The vertue of pot ashes (which the dyers
Observations on the Author.

dyers call ware) is seen in their working of Indico and Woad, neither of which without these ashes will yield their tincture; for the lightest colours use only a solution of Alum for stronger Salts destroy their colours, as in dying Soap ashes, mars the yellow of Weed or Fustick, and in Chap. 4. Tartar will not make Yellow in Glass.

Chap. 110. Whatever herb, or flower. The tryal of our Author is good, but stainning of linnen is a better sign. The rule given by the Merchant to the Mariners in their instructions for foreign voyages, is to chew the plant, and if that colour tinge the spittle deep 'tis good, otherwise not, and so with linnen or fine white paper.

I shall here give you a catalogue of many plants, &c. which give a colour, and consequently are fit to make Lakes of, and first those of the dyers, as Log-wood, three sorts of Fusticks for Yellows, Green, old and young. Campagiana and Sylvester, which are two sorts of grains or small berries brought from the West-Indies, they make a grain colour, though not so good as Cochineel, yet they are used in stead thereof. Red-wood, Symach, Brash

filetto,
filetto, or Sweet-wood, Turmeric, Safflower, that is, Saffron-flower, but not that of the Crocus, but of the Carthamus brought from Italy, Anotto made of the Fucus Marinus Tinctorius, stale and grease, which yields a fair Scarlet. Weed, that is, Genista Tinctoria, for a Yellow colour.

Others not used in dying are Saffron, Pha-langium Tradescanti, a very deep and fair Blew. Cyanus an excellent Skie for Dyers. Alga marina Tinctoria distinct from the former Fucus, both mentioned by Joan. Bauhin. Harebels, our Purple Colchicum. A triplex Baccifera a deep Red, Heliotropium in whose juice rags insuccated make Turnsole. Blattaria with a Blew, and also with a Yellow flower, and the Convolvulus narrow leafed of America; some plants have a coloured juyce, as the Spurges, Sow-thistles, Dandelion, Tragopogon, Periplocas, Rampions, Lettices, &c. most whereof dried in the Sun turn Yellowish (which makes me suppose Camboja may be the juyce of some Spurge.) But Saint Johns and Saint Peters Wurt, and Tutsan have a reddish juyce in their tops. Celandine the greater, and Felsel Alpini give a Yellowish juyce. The Berries of many plants,
Observations on the Author. 337

plants, also affords colours, as Dwale garden, Night-shade, the Bryonies, Ruscus, Solumons Seal, Herb Christopher, Rasberries, Great-bearing-Cherries, Spina Cervina, the Painters Sap-green, Wall-nuts, Bezza, Seu Torna folis Bezedini of Wormius in his Musæum, l. 2. c. 34. who thus describes it. 'Tis a fine linen cloth impregnated with a most Red and Elegant Tincture, But how 'tis prepared, and what is the way of making it, the donor of it Christopher Herfurtt the Apothecary of King Christian the fifth knew not. It seems to be the tincture of Red-landers, wherewith the Cloath is coloured. They use it as Turnsole to colour the body and dishes of meat Red: But this is far neater than that, fit for Cosmeticks, having this peculiar that steeped in water it communicates its colour thereunto, scarcely to wine, but in no wise to Spirit of Wine, so far be. I have seen this tincture, but made with Cotton-wool, and 'tis used for a Fucus, and common enough with us, and without doubt a singular good Lake might be made therewith. Amaranthi, baslautitia the seed of Heliotropium tricoccum that at first rubbing gives a Green, then a Blew, and lastly a Purple as Libav. fragments of the Alaternus as Clus give a Black,
Chap. 113. A Mixture to make Spheres.

Many compositions I find in Authors, and because they are of singular use in the Opticks, and nothing published thereof in our own language, I shall here give you such as I have met with. Those Spheres or Glasses are call'd Metalline, not because they are made of metall, but because some Metalline bodys are mixed with them, and they do as to weight, and appearance much resemble them. Porta. Mag. 1. 17. c. 23.

Thus prepares the mixture for them. Take a new pot that will bear the fire, luted within, dry it twice or thrice, melt therein of Tartar and Crystalline Arsnick of each two pound, when you see them smoak, put in fifty pound of old worn-brass, melt them six or seven times, that they may be purified and refined, then presently add twenty five pound of English Tin, and melt them all together. Take a little thereof with an Iron out of the pot, and try whether it be brittle or hard; if brittle add Brass, if hard, Tin, or else boil it till some of the Tin fly away, when it hath the desired temper, cast upon it two ounces of Borax, and let it alone till the fume be gone. Then cast it into a mold and let it cool, when cold rub it with a Pumice, then with Emeric, when
when you see the superficies smooth and polished, rub it with Tripoly, and lastly with st Tin give it light and lustre. Most add a third part of Tin to the Brass, that the mass may be harder, and acquire greater perspicuity.

Porta l. 4. c. 23. Of his former edition, thus compounds this mixture. 'Tis thus commonly made by all men. Brass, and a triple of Tin, a little Arsnick and Tartar, that they may melt, and be incorporated; some add a triple quantity of Brass to Tin a little stibium, silver and the White Pyrites; some make it of Lead and a double of silver, and 'tis made of other metalls, and otherwise tempered. When they are cast into molds they must be polished and smoothed, that the reflected Ray may bring with it the resemblance of things, and imitate a Looking Glass. Whereunto the smoothness and fitness of the parts much conduceth. If the mixture be not smooth enough, cut or grind it, that on one side the image represented may be bigger, and on the other less, and different. If it be rough apply it to the wheel, where arms are polished, and so 'tis burnished. If you make the glass Concave or Convex, let the motion of the wheel should break the Glass plain a piece of wood, and make it of the shape of
342 Observations on the Author.

of your Glass, and fasten it on with pitch that it stir not. Then rub it over with fine powder of Emery with a Cloath or Lether, then with fine powder of the Pumice-stone, or whilst it sticks to the wood with Putty (so the Goldsmiths call Tin calcin'd) mixed with Tripoly. And for the last polishing with Tartar, Soot and ashes of Willows or Juniper, which will make it shine best of all. Emery is prepared by powdering sercing and wetting.

Cardan. l. 2. de variet. c. 57. Glasses call'd Steel-Glasses are made of three parts of Brass, of one part of Tin and Silver, and an 18th part of Antimony. Most leave out the silver for the charge, others add only a 24th part, as Aldrovand. l. 1. c. 4. Musæi Metall relates. Some make it of a pound of Tin, a third of Brass melted, and then add an ounce of Tartar, and half an ounce of white Orpimont, all boil so long as they smoak. Then they fashion the Molten Metall into the figure of a Looking-Glass, on plain tables, heated and dried with the smoak of Rosin, and smoothed with vine ashes, then they afterwards smooth it glewed to Wood with water, and sand, next with Emery, or a smooth Pumice,
Pumice, thirdly with Putty, thus Cardan, and from him Kircher and Schwenterus.

Harstoffer. tom. 1. par. 6. q. 13. deliciar. Math. from Fliorovant, takes three quarters of Tin, and a quarter of refined Copper and melts them, then four ounces of calcin'd Tartar, Crystalline Antimony six ounces, Antimony sublim'd two ounces, common oyl four ounces, Marcasite three ounces: Mix all these, and to every pound of the said mettalls, take thereof two ounces, let them evaporate and refine, adding a little Burgundie-pitch, when these are consumed pour the stuff in the molds.

Scal. exerc. 82. Sect. 3. thus of this mixture, melt nine ounces of Tin, three of Brass, and then add dryed Tartar one ounce, white Arsnick half an ounce, let them stand on the fire as long as they smoak, and in the casting, and polishing proceeds as the other Authors.

Cornæus communicated to Schottus this way. Take ten parts of Copper, when 'tis melted, add four parts of Tin, then sprinkle a little Antimony and Sal Armoniack, and stir and mix them till all the dangerous smoak.
Observations on the Author.

(from which keep your mouth and nose) van- 

nish, then cast it into a mold. I have found 

(faith be) this mixture by much use to be 

very good.

Some of these mixtures, and many others 

like, with divers other materials for polishing 

you may find in Birelli, I. 9. c. 47. to the 55. 

to whom for brevities sake I refer you.

Chap. 114. T

This way of colouring Glass 

Balls on the inside, is now 

changed into another of Pasting Pictures on 

the outside of Balls, they are very pleasant, com-

monly hung up in houses.

Gesso, whereof thus Caesalp. 1. 1. c. 9. 

( the onely Latin Author I find mention it ) 

est alia terra pallida glebis lapidosis qua 

utuntur ad Aurichalcum tergendum, vulgo 

vacant gessum. There's another pale earth with 

siony clots, which they use to scoure Bras, they 

call it Gessum. But it seems he knew not 

what it was, 'Tis a sort of Lime burnt into a 

pretty hard and very white siony substance, 

glittering with spots, as Spar doth in Lead and 

Tin Ore, and pretty ponderous. To the eye it 
much resembles Alabaster, and is brittle as it,
for so is a large piece I have by me. 'Tis made in Spain, and carried thence to the Canary Islands, and put into the wine transported thence, and gives it a whitish colour and fermentation, and so preserves that wine which would not otherwise keep, but would grow vapid, being transported into other countries.

Chap. 115. Ultramarine, so call'd as Caesalp. quod forte Egyptum significat aliis prælatum, this most beautiful colour, and of value equal, if not surpassing Gold, all Authors that treat of stones or colours, deliver the ways of preparing it. 'Tis a very nice colour to make, and unless all the Lapis Lazuli you use be singularly good, all your labour is lost. 'Tis sufficient for me to point at the Authors, who have written of it, omitting their processes, because very long and tedious. Boeth. de Boodt. de gem & Lap. l. 2. c. 123, 124. to Chap. 142. Where he teacheth in a long series of words, to chose the stones (for some of them will bear the fire which Aldrovand. cart fixed, others will lose their colour in the fire) then the way to calcine it, to make vessels, Lees, strong and weaker Plasters, wherewith the colours may be more easily drawn
drawn forth, and how it must be washed to serve for Pictures. And in the last Chapter he teacheth a shorter and less expensive way to extract this colour. Next him followeth Birelli, who somewhat shorter delivers all these processes, l. 9. from Chap. 80. to Chap. 109. Some painters onely grind the Lapis Lazuli into a fine powder, and so use it.

Chap. 116. L Ake from Cochineel. No doubt this word comes from the Gum call’d Lacca, the colour and tincture whereof have both the same colour, with this of the Painters. Math. in l. 1. Diosc. c. 23. asserts there are many kinds of Artificial Lake which are made of the Sediment of several tinctures. One is made of the Berry (head) of Burnet which they commonly call Cremese and Cremesino (Crimson) another of Chermes Berries, a third of true Gum-lacc, and lastly a fourth of Brasil, the worst of all, but he sheweth not the way of making either of them.

Concerning this place, and the mistakes of Math. herein, hereafter in a Treatise designed for colours, Birell. l. 11. c. 39. teacheth a way to make a Lake of this Gum. Take (saith he)
Observations on the Author. 347

He) about twenty pound of mens urine, which boil and scum well, put a pound of Gum-lacc, and five ounces of Alum into it, set them over the fire. Boil them till the colour be extracted, make proof with a little of it, then add of Alumen Saccharinum, what quantity you judge fit, then strein it as the other Lakes are.

I find in several writers receits for making Lakes, differing onely, either in the materials from which, or in respect of the Menstruum therewith they are extracted. Some use Chermes-berrys or Grains (a sirup whereof the Apothecaries have of a noble tincture) and they are gathered from the Ilex thence call'd Coccigera, a tree whereof you may see in a garden in Old-street, London, near the Pest-house, but it never bore fruit in England, another grew in his Majesties Privy-garden at White-hall, but 'twas lately cut down, by the ignorant usurpers. Some use the Cochineel, which is a Maggot or fly bred on the Ficus Indica, whereof see at large, Joan de Laet descript. Ind. l. 5. c. 3. as also Herrera & Zimenes. Others use dyed Flox (the most common) which our Author here teacheth how to die, and this is the best way. Others take the Scourings of Cloth dyed in Stammel or Scarlet.
Hernandez in his Hist. 1. 3. chap. 45, thus of making Lake in the Indies. Of Nocheztli, that is Cochineel, sometimes a Purple, sometimes a Scarlet colour is made, according to the various ways of preparing it.

The most exquisite is made by beating it with the water of the distraction of the tree call'd Totzuatl, adding Alum, and the setting is form'd into Cakes.

As for the Menstruums they are Lees made by our Author of Vine or Willow, or of other soft Wood. Others make it of Oaken or other strong ashes, yet the Lee must be no stronger than being put upon the tongue, 'twill prick or bite it a little only. Surely Aqua-fortis might do very well, since we see it so far advanceth the colour of Cochineel in our incomparable Bow-dyes. The only inconvenience in Lakes hence made would be, that they would soon Tarnish and lose their colour in the air, or with wet, by reason of the Salts relenting; but perhaps this might be remedied by extracting and washing of these Salts without any damage to the colour. Now all writers proceed the same way in discharging the
Observations on the Author.

the colour, precipitating streyning aad drying the Lake made. As to the last I shall add this, that Chalk-stones sooner dry by imbibing the moisture than Bricks do, as the constant practice of Painters in making Pastils, and of the Refiners in drying their Verditers confirmeth. Before the Lake be fully dry, they form it into Balls, or cut it with a wooden Knife (not with an Iron one) into what shapes and figures they please, or they may do as Painters for their Pastils, cast them in furrows made in the stone.

Chap. 117. S Aline of the Levant, with my Author Pilatro di Levante; this word Pilatro I cannot find in any Italian writer, this exposition of the word I had from an ancient person who wrought at Moran, he added 'twas a Salt extracted from the froath of the Sea, coagulated through the extreme heat of the countrey. The name of Saline, and this way of generation thereof I have had from other workmen, but the exposition from him alone.
Chap. 118. \textit{Birelli} makes his Lake from Brasil thus, He first extracts a tincture from Flox, and then takes a pound of Brasil cut (ground is better) and boils the Lee to the consumption of a fingers thickness, then strains it, and adds to the strained liquor one ounce of Gum Arabick in powder, and reboils it, and boils away half as much as before, then mixeth both the liquors with a stick, then proceeds with the Hippocras-bag, &c. as before.

Chap. 124. A Fair rose Red Rosichiero, which Porta, l. 6. c.9. calls Rosaclerum, & teacheth this way of making it. Put 10 pound of Crystall into a pot, when 'tis well melted, put in a pound of the best Minium by halves at a time, stir them speedily, then with Iron ladles cast them into water, and that thrice, then mix five ounces of calcin'd Brass and Cin- naber of the deepest colour, and having stirr'd them well, let them settle three hours. When you have so done superadd of Glass of Tin three ounces, mix them without intermission and you shall see in the Glass the most Florid colour of the Rose, which you may use to Enamel upon Gold.
Chap. 126. To fix Sulphur he teacheth another way, Chap. 129.

Another Process to the same purpose, but much larger, Birel delivers, l. i. c. 50. But Sulphur thus prepared will easily rise sublim'd with Sal Armoniack. None that I have met with affirms such a fixation of Sulphur, as Helmont doth, for in his mixture of Elements, he saith, he knew ways whereby whatsoever Sulphur was once dissolved, might be fixed into a Terrestrial powder. Our Author nowhere mentions any use of this powder in the Art of Glass.

Chap. 129. A Transparent Red. Libav. l. 2. Tract. i. c. 35. By conjecture hits right on this colour from Gold in these words. I judge that from a red tincture of Gold dissolved into a liquour or oyl, and especially with Crystal, a Rubie may not unfitly be made. Of which conjecture he assigns this reason, because Rubies are frequent where Gold is found, and therefore 'tis consentaneous that gold there doth degenerate into this jewel.
Chap. 13. To make vitriolum Veneris, Glaub. 1. 2. Furn. Philosop. proposeth this short way. Spirit of Sal Armoniac powered on calcin'd Copper, made by frequent ignition and extinction, in an hours space extracts a Blew colour, which when dissolved, decant off, and set in a cold place, and 'twill yield a most elegant Blew Vitriol. Croll. in his Basil. Chym. describes well the making of this Medicine. Beguin, c. 17. sets down this way, Powder calcin'd Copper, or it's scales very fine, which digest 24 hours in distil'd vineger. Pour out the Tinctured Vineger by inclination, and pour on more till 'twill be no more coloured. Filtre the decanted liqueurs, Evaporate, or distil off a third part, set the remainder in a cold place, and you shall have Green and obscure Vitriolum Veneris.

FINIS.
AN ACCOUNT OF THE GLASS DROPS.

These Drops were first brought into England by His Highness Prince Rupert out of Germany, and shewed to his Majesty, who communicated them to His Society at Gresham College. A Committee was appointed forthwith by the Society, who gave this following Account of them, as 'tis Registered in their Book appointed for that purpose, and thence transcribed by their permission, and here published. The which I the rather desired, that this might be a pattern for A a experien-
An account of the Glass Drops. Experiments to be made in any kinde whatsoever, as being done with exceeding exactness.

This account was given to the Society by Sir Robert Moray. MDCLXI.

A B the thread, B C the body, B the neck, A the point or end of the thread.

They are made of green-glass well refined; till the Metall (as they call it) be well refined, they not at all succeed, but crack and break, soon after they are drop't into the water. 
The best way of making them, is to take up some of the Metall out of the pot upon the end of an Iron rod, and immediately let it drop into cold water, and there lye till it cool.

If the Metall be too hot when it drops into the water, the Glass drop certainly frosts and cracks all over, and falls to pieces in the water.

Every one that Cracks not in the water, and lies in it, till it be quite cold, is sure to be good.

The most expert Workmen, know not the just temper of heat, that is requisite, and therefore cannot promise before hand to make one that shall prove good, and many of them miscarry in the making, sometimes two or three, or more for one that hits.

Some of them frost, but the body falls not into pieces; others break into pieces before the red heat be quite over, and with a small noise; other soon after the red heat is over, and with a great noise; some neither break nor crack, till they seem to be quite cold; others keep whole whilst they are in the water, and fly to pieces of themselves with a smart noise as soon
An account of the Glass Drops.

soon as they are taken out of the water; some an hour after, others keep whole some days or weeks, and then break without being touched.

If one of them be snatched out of the water whilst it is red hot, the small part of the neck, and so much of the thred or string it hangs by, as has been in the water, will upon breaking fall into small parts, but not the Body, although it have as large cavities in it, as those that fly in pieces.

If one of them be cooled in the air, hanging at a thread, or on the ground, it becomes like other Glass, in all respects, as solidity, &c.

When a Glass drop falls into the water, it makes a little hissing noise, the body of it continues red a pretty while, and and there proceed from it many eruptions like sparkles, that crack, and make it leap up and move, and many bubbles do arise from it in the water, every where about it, till it cool; but if the water be ten or twelve Inches deep, these bubbles diminish so in the ascending, that they vanish before they attain the superficies of the water; where nothing is to be observed, but a little thin steam.
An account of the Glass Drops.

The outside of the Glass drop is close and smooth like other Glass, but within it is spungious, and full of Cavities or Blebs.

The figure of it is roundish at the bottom for the most part, not unlike a pear pearl, it terminates in a long neck, so that never any of them are straight, and most of them are Crooked and bowed into small folds and wreaths from the beginning of the neck till it end in a small point.

Almost all those that are made in water have a little protuberance or knob a little above the largest part of the body, and most commonly placed on the side towards which the neck ends, although sometimes it be upon that side that lies uppermost in the vessel where it is made.

If a Glass drop be let fall into water scalding hot, it will be sure to crack and break in the water either before the red heat be over, or soon after.

In Sallet Oyl they do not miscarry so frequently as in cold water.

In oyl they produce a greater number of bubbles, and larger ones, and they
An account of the Glass Drops.

- Those that are made in oil have not so many, nor so large blebs in them, as those made in water, and divers of them are smooth all over, and want those little knobs that the others have.

- Some part of the neck of those that are made in oil, and that part of the small thread that is quenched in it cool'd, breaks like common Glass. But if the neck be broken near the body, and the body held close in ones hand, it will crack and break all over; but flies not into so small parts, nor with so smart a force and noise as those made in water, and the pieces will hold together till they be parted; and then there appears long streaks or rays upon them, pointing towards the center or middle of the body, and thwarting the little blebs or cavities of it, wherof the number is not so great, nor the size so large as in those made in water; if the Glass drops be dropt into vinegar, they frost and crack, so as they are sure to fall to pieces before they be cold, the noise of falling in is more hissing than in water, but the bubbles not so remarkable.

In milk they make no noise, nor any bubbles
bubbles that can be perceived, and never
miss to frost and crack, and fall in pieces
before they be cold.

In spirit of wine they bubble more than
in any of the other liquors, and while they
remain entire, tumble too and fro, and are
more agitated than in other liquors,
and never fail to crack and fall in pie-
ces.

By that time five or six are dropt into
the spirit of wine, it will be set on flame:
but receive, no particular taste from
them.

In water wherein Nitre or Sal Armoniack
hath been dissolved, they succeed no better
than in vineger.

In oyl of Turpentine one of them broke,
as in the spirit of wine, but the second set it
on fire, so as it could no more be u-
fed.

In Quick-silver, being forced to sink
with a stick, it grew flat and rough on
the upper side: but the experiment could
not be perfected, because it could not be
kept under till it cool'd.

In an experiment made in a Cylindrical
Glass, like a beaker filled with cold water,
of seven or eight only one succeeded, the
rest

Aa 4
An account of the Glass Drops.

rest all cracking and breaking into pieces, onely some of the company, who taking the Glass in their hand, assoon as the drop was let fall into it, observed that at the first falling in, and for some time after, whilst the red heat lasted, red sparks were shot forth from the drops into the water, and that at the instant of the eruption of those particles, and of the bubbles which manifestly break out of it into the water, it not only cracks and sometimes with considerable noise, but the body moves and leaps, as well of those that remain whole in the water, as those that break.

A blow with a small hammer, or other hard tool will not break one of the Glass Drops made in water, if it be touched nowhere but on the body.

Break of the tip of it, and it will fly immediately into very minute parts with a smart force, and noise, and these parts will easily crumble into a coarse dust.

If it be broken, so that the sparks of it may have liberty to fly every way, they will disperse themselves in an orb, with violence like a little Granado.

Some
An account of the Glass Drops.

Some being rubed upon a dry tyle, fly into pieces by that time the bottom is a little flattened, others not till half be rub'd off. One being rub'd till about half was ground away, and then layed aside, did a little while after, fly in pieces without being touched. Another rub'd almost to the very neck on a stone with water and Emery did not fly at all.

If one of them be broken in ones hand under water, it strikes the hand more smartly, and with a more brisk noise than in the air; yea, though it be held near the superficies, none of the small parts will fly out of it, but all fall down without dispersing as they do in the Air. One of them broken in Master Boyles Engine, when the Receiver is well Evacuated will fly in pieces as in the open air.

Anneal one of them in the fire, and it will become like ordinary Glass, onely the spring of it is so weakned, that it will not bend so much without breaking, as before.

A Glass drop being fastned into a cement all but a part of the neck, and then the tip of it broken off, it made a pretty smart noise, but not so great as those use to do that
An account of the Glass Drops.

That are broken in the hand, and though it clearly appears to be all shiver'd within, and the colours turned grayish, the outside remained smooth, though cracked, and being taken in pieces, the parts of it rise in flakes, some Conical in shape, and so crack all over, that it easily crumbled to dust.

One fastned in a ball of cement some half an Inch in thickness, upon the breaking off the tip of it, it broke the ball in pieces like a Granado.

Two or three of them sent to a Lapidary to pierce them thorow, as they do Pearls, no sooner had the tool entred into them, but they flew in pieces as they use to do when the tip of them is broken off.

FINIS.
An Appendix.

In the Chapter of the Furnaces I gave an account of the Instruments used about Crystalline Metall, but having omitted there those which are used in making Green Glasses, take them here as they follow.

Two Bars to lift their pots into the Furnaces, each near four yards long.

A Padle to stir and move the Ashes and Sand in the Calcar.

Rakes to rake the Ashes and Sand too and fro in the Calcar.

Procers are Irons hooked at the extremity to settle the Pots in their places, whether set too far or near, or on either side from the working hole.

Ladles to empty out the Metall from one Pot into another, whether the Pots break, or to any other purpose.

Small Ladles for each Master workman to scum the Sandeover, and dross, from the pot wherein he worketh.

Strocals a long Iron instrument like a Fire-shovel to carry the Metall out of a broken into a whole Pot.

Forks
An Appendix.

Forks to prick betwixt the bars of the Fire-place to help the descent of the ashes, that the fire may burn clear, and bright.

Sleepers are the great Iron bars crossing smaller ones which hinder the passing of the coals, but give passage to the descent of the ashes.

Ferrets are the Irons wherewith they try whether the Metall be fit to work, as also those Irons which make the Ring at the mouth of Glass Bottles.

Fascets are Irons thrust into the bottle to carry them to anneal.

The Pipes are the hollow Irons to blow the Glass.

Ponte is the Iron to stick the Glass at the bottom for the more convenient fashioning the neck of it.

Pontee stake is the Iron whereon the Servitors place the Irons from the Masters when they have knock't off the broken pieces of Glass.

Cassia stake is that Iron whereon lyeth a piece of wood, on which wood they lay the Glass when they have taken it off the pipes, & whereon they turn the Glass to fasten the Pontee to it.

Shears are the Instruments to form and fashion the Glass.

Scissors cut the Glass, and even it.
An Appendix.

Cranny is a round Iron whereon they roll the Glass to make the neck of it small.

Tower is the Iron on which they rest their Pontee when they scald the Glass.

Several sorts of Iron Molds wherein they make their works of several figures, protuberances, &c. according as they are cut in them.

FINIS.
Errata Corrigenda.


Carelyn Horton & Assoc.
430 West 22 Street
New York, N.Y. 10011