

★ OF-GEMS & GEM-CUTTING ★

MINERALOGY · EMERALD · AND · OTHER · BERYLS · CATALOG

★ GEMSTONES · OF · NORTH · AME · RICA · PROSPECTING · FOR · GEM ·



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★ MINERALS · AND · STONES ·



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Ex Æd. Sab.      G. Stradling Rever. in Christo  
10. sept.      Pat. Gilb. Episc. Lond.  
1662.      Sacell. Domest.



THE  
Art of Glafs,

WHEREIN

Are shown the wayes to  
make and colour Glafs, Pastes, Ena-  
mels, 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  
Glafs Drops, made by the Royal Society,  
meeting at *Gresham College*.



---

L O N D O N,

Printed by *A. W.* for *Octavian Pulleyn*, at  
the Sign of the *Rose* in *S. Pauls*  
Church-yard. *M D C L X I I.*



Art of Glass

IN

Two Volumes in One

By Thomas Digby

London Printed by W. Stansfeld

1701

Printed by W. Stansfeld

at the Sign of the Gun

in St. Dunstons Church

Street


LONDON

Printed by W. Stansfeld



To the most Illustrious and  
Excellent Lord *Don*  
*Antonio Medici.*

*Antonio Neri.*

AVING 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 ma-  
ny 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 Chymi-  
cal 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 Excel-  
lence, 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 vertue of your most Illustrious Excellence, for whom I pray to God to prove on you all happiness.

*From Florence,*

6 Jan. 1611.

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To

The first of these  
is the noble and illustrious  
and wise, being learned  
usually in all the Arts, which  
are required in a true and good  
young Prince, I believe you think  
to accept it that the world yet my  
devout mind towards your great  
merit, and welfare of your majesty  
hitherto I collected for what  
I can do to bear on your  
happiness.

Yours  
L. J.



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To the Curious  
Reader.

**H**ere 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 permanencie in it; likewise as the perfect and shining Metall of Gold, it is refined, and burnished, and made beautiful in the fire. It is manifest that it's use in drinking vessels, and other things profitable for mans service, is much more gentile, graceful, 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 Spagyricall, not to say necessary to prepare Medicines for man, which would be impossible

A

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, Athernors, Serpentine, 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 mans 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 aboundant 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 Alchemists; 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*



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 it's 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 Sphers, 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 perswadcd 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 trying my receipts, 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 something, and especially they which have never handled such things; For it is impossible that they at the first time should be masters: therefore 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 determinate dose cannot be given: but with experience and practice one must learn, and with eye and judgment know when Glass is sufficiently coloured, conformable to the work, for which it ought to serve, and in Paste made in imitation of Jewels conformable to the size, whereof they will make them, Observing that those which are to be set in Gold, with Foyle, as in Rings, or other where, must always be clear, and  
of

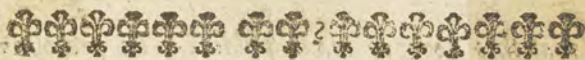


## To the Curious Reader.<sup>v</sup>

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 exquisite work, may be the securer, let him prepare, & make all the colours himself as I teach, for so he shall be sure that his work must happily succeed. The fire in this Art is of notable 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 hurteth, and endamageth it, especially in furnaces, where the vessels and pots stand open, and the Glasse will then receive imperfection, and notable foulness. Moreover, I say that if the operator shall be diligent, and shall do like a diligent and practised 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 encouraged perhaps to publish my other labors wrought for many years in divers parts of the world in the Chymical and Spagyricall Arts, than which I think there is no greater thing in nature for mans service, known and perfect in ancient times; which made men expert 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 practice. 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,

**T**His Treatise challengeth the inscripti-  
on of Your name for many reasons.  
The Author of it Dedicated this piece  
to a Person of Honour, and eminent parts,  
both which concurr 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 onely Your great progress & singular know-  
ledge, but have also taught it the true use of  
that most beneficial Art, as to the improve-  
ment of Reason and Philosophie. Most Writers  
therein delivering onely a farrago of processes  
and unintelligible Enigm's. But You have  
chalked out the way of solid reasoning upon  
whatsoever occurs to observation in such ex-  
periments. 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 intellectuals ready to excuse the errors, and slips whatsoever of,

Sir, Your most humble  
and most regard-  
ful Servant,  
C. M.



## To the ingenuous Reader.

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 thoroughout the whole, so often repeated the same thing, by advice of some ingenuous persons, I left out those repetitions, and have either before the Books given a general account of these repetitions, or else have referr'd 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? or to repeat the same process, and rules in each new colour for Pastes 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 pass'd 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 surveid 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



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To the Ingenious Reader.

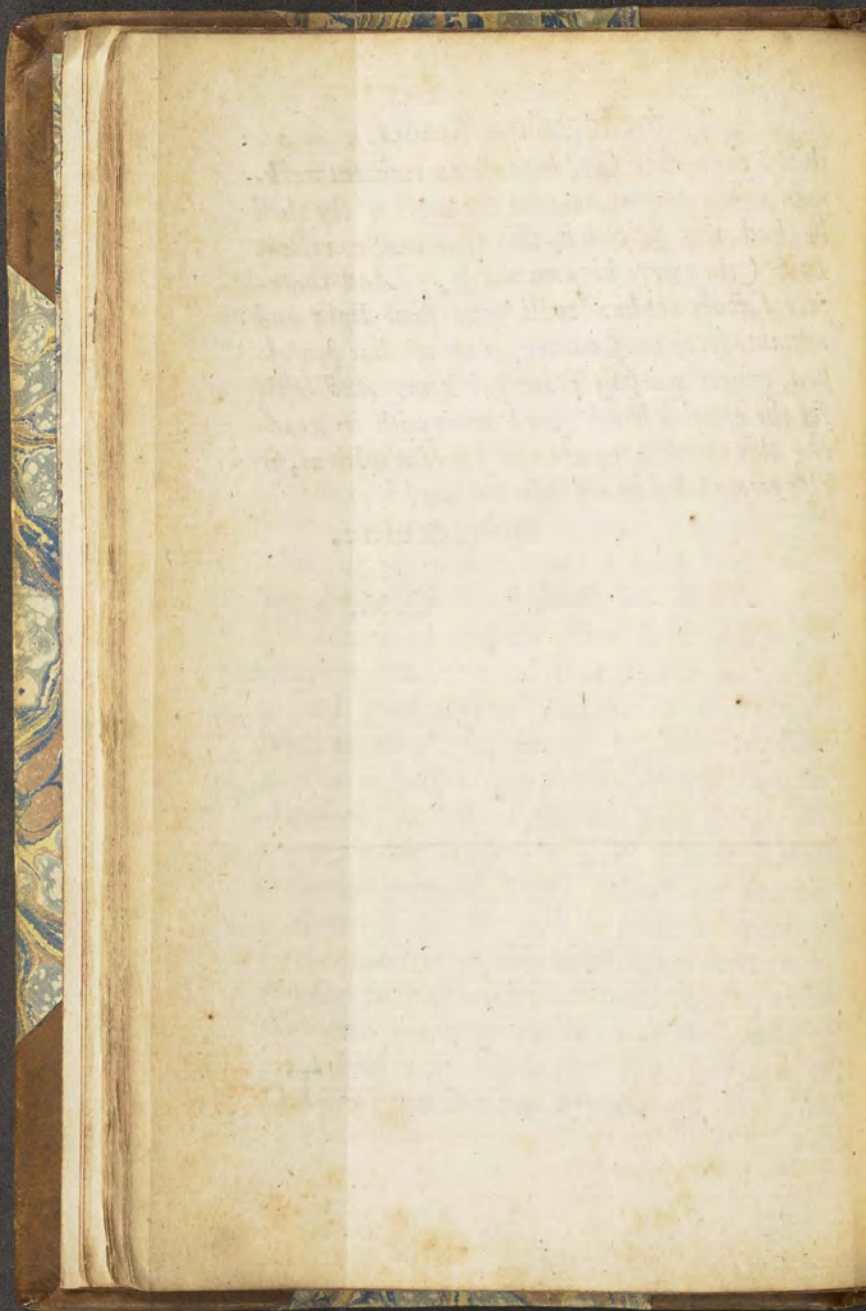
this I the rather say, because an eminent work-  
man, now a Master, told me the most of the skill  
he had was gain'd by this true and excellent  
Book (they were his own words,) And there-  
fore I doubt not but 'twill give some light and  
advantage to our Countrey-men of that profes-  
sion, which was my principal aim. And lastly  
for the exotick words you'l meet with in Read-  
ing this Book they are now current with us, or  
else expounded in my observations.

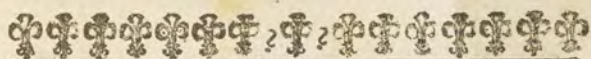
Fruere & utere.

*Christopher*  
C. Merret

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To





## To avoid our Authors Re- petitions, Observe

1. **A**ll 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 other-  
wise sink to the bottom of the pot) with the  
metall that the Glass may be colour'd through-  
out. 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 green-  
ness 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.







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 tasting what salt they contain: but the safest 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, alwaies 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, 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 ren daies, 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 daies, which by the settling of more terrestriety 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 terrestriety, wherewith a very fine and perfect salt is made. Let the coppers be filled again, and boyl 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 boyl 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 easie 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 moysture, which happens in more, or fewer daies, according to the season in which it is



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 dried, 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 dried 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 thorough, exceed not the bignets of a grain of wheat.

This salt thus pounded, sifted and dried, must be kept by it self, in a place free from dust, for to make *Fritt* of *Cry-stall*: the way to make this *Fritt* is this which follows;

The way to make Fritt for Crystall,  
otherwise called Bollito.

CH A P. II.

**W**Hen you would make fair, and fully perfect Crystall, 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 glafs and Crystall, and those which strike not fire with a steel, will never virrifie, which serves for advice to know the stones that may be transmuted, from those that will not be transmuted into glafs.

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 Crytall. 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 chrystile, 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 Crystill 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 it self 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 Crystill Fritt, with the dose and circumstances, which I have oft times used.

Another

Another way to extract the salt of Polverine, which makes a Crystall as fair and clear as natural Crystall: This was my invention.

### C H A P. III.

**T**AKE *Polverine* of the *Levant* well serced, 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 tast 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 filtred, and stand  
in



in glased 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 glais bodies, luted at the bottom, in furnaces, in ashes, or sand, at a gentle fire, and at last when the stuff is dried, 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 glased, 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.

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*An observation for Gold Yellow, in Crystall.*

#### C H A P. IV.

**O**BSERVE 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-  
with-

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.*

C H A P. V.

**I**N *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 said 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 with-



thereth, then let it be well burn-  
 ed 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 serced *Tarso*, the which Fritt  
 melts well in the pot, and yieldeth a fait  
 Crystall, and much better than the ordina-  
 ry Crystall, because it had more strength  
 and bended much better, which the ordi-  
 nary Crystall doth not, it is drawn into  
 fine threds, 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 Cry-  
 stal 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*



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*The way to make another Salt which will produce a marvellous and wonderful Cryſtall.*

## C H A P. VI.

**L**Et 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 aboveſaid 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 ſen 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.

C H A P. VII.

**T**Ake 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 clarify, 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

The way to make ordinary Fritt, to wit of *Polverine*, *Rochetta*, and *Barillia* of Spain.

C H A P. VIII.

**F**RITT 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 *Cry-stall*; *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.

C

To



To make then Fritt, serce the *Polverine* thorow a fine serce, 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 serce; for as the common proverb in this art saith, A fine serce, 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 *Arnus*, 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 it self, 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-



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 thorow 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.



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To make Crystall in full perfection,  
the way I always practice.

## C H A P. IX.

**T**Ake Crystall Fritt diligently made, set it in pots in the furnace, where there are no pots with colours, for the fumes of metallis whereof 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 metallis cannot be precisely determined either by weight or measure, but must be wholly left to the eye and judgement, tryal and experience of the Conciatore. To make a fair Crystal, when it is well melted take it from the pots, and cast

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 Crystill, 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 re-  
peated 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 black-  
ish tincture. When it is boiled and clear, see  
whether it hath enough *Manganesse*, and if  
it be greenish, give it *Manganesse* with dis-  
cretion. Wherefore to make good Crystill  
put in the *Manganesse* by little and little at  
a time, for it makes the Crystill of a murry  
colour, which afterward inclines to black,  
taking from it it's splendor; mix the *Man-  
ganesse*, and let the glass clarifie till it be-  
comes of a clear and shining colour. The  
property of *Manganesse* is, being put in  
just quantity to take away the foul greasines  
which Crystill 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.

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

C H A P. X.

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



fair, clear, and in perfection. Although glass 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.

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To make Purified Salt of Tartar, for  
the work abovesaid.

## C H A P. XI.

**T**AKE *Tartar* of red wine in great lumps,  
and not in powder, Calcine it in  
earthen pots between live coles till it be-  
come 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 heat-  
ed, as also into earthen pots glased, & make  
it boil with a gentle soft fire in such sort  
that a quarter of the water may be exha-  
led in two hours, then take them from the  
fire, and suffer the water to cool, and be-  
come 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



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, Filtring, 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* terced 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.



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To prepare Zaffer which serves for many colours.

C H A P. 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 vinegar, as soon as 'tis cold grind it fine on a Porphyrie stone, wash it in earthen pans glased, 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.

C H A P. XIII.

**T**AKE *Manganese* of *Piemont*, for this is the best of all the *Manganese*s at this day known in the art of glass. At *Venice* there's not alwayes 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.

## C H A P. XIV.

TO make *Ferretto* is nothing but a simple Calcination of Copper, that the metall being opened, may communicate it's 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 easie 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 Calcin'd, 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 serced in a fine serce is kept well closed for use.

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*Another way to make Ferretto of Spain.*

C H A P. X V.

**T**His 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, neer the occhio, then take it out & make another SSS with new Vitriol, keep it in reverberation as before, & this Calcination with Cop-  
peras

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.

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

C H A P. XVI.

**C**rocus Martis is nothing else but a subtilising and Calcination of Iron, by means whereof it's tincture (which is most red in glass) is so opened that it communiceth 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 serce them thorow a fine serce, and put them into a Chrystile 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 reddis 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.

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*The second way to make Crocus Martis.*

C H A P. XVII.

**T**His 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 vinegar, onely sprinkling them so much that



that they may be wet thorowout, 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 serce them fine, and you have a most fine powder of the colour of brick powdred, which keep in vessels to colour glafs.

*A third way to make Crocus Martis.*

C H A P. XVIII.

**T**His 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 glafs 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  
 D have

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

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*A fourth way to make Crocus Martis.*

CHAP. XIX.

**T**His 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 onely 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 leasurely, & 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



some will be found a most noble *Crocus Martis* for the most stupendious tinctures of glasses, which keep for use.

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

C H A P. XX.

**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 it into a Chryfible 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 serce 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, serce, and keep it for use. The sign that it is well Calcined is, that if it be put into glafs it makes it swell, and when it makes not the glafs 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 glafs boil, neither doth it colour well.

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To Calcine the said Brass, after another manner, to make a transparent red, a yellow, and Calci-dony.

C H A P. XXI.

TAKE Brass and cut it small with sheers, and put it in a melting pot, make a SSS. 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, serce, and put it covered upon tiles of earth into the furnace, for 12 days, to reverberate, then grind, powder, and keep it for use.

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*Sea-green in glass, a principal colour  
in the Art.*

CH A P. XXII.

**S**Ea-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, onely 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



by the Conciators, take it out with much diligence, for what remains thereof, will make a foul, and oyle 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 well united, mixed, and spread thorough all the metall, otherwise it settles to the bottom, and the metall at the top becomes clear. This manner of making Sea-green, 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.

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*Skie Colour or Sea-green.*

CHAP. XXIII.

**S**Et 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.

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*A Red colour from Brass for many colours.*

C H A P. XXIV.

**T**Ake 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*



*Brass thrice Calcined to colour  
glass.*

C H A P. XXV.

**P**ut 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 purified metal it makes it swell & boil suddainly, and when it doth not so it is not good nor well Calcin'd.

*A Sea-green in Artificial Crystal.*

## C H A P. 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 blewishness. 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 er-  
ring. And if a moytie of *Rochetta* first be  
mixed with Crystal Frit, there will arise a  
fair Sea-green, and in Crystal alone 'tis  
marvellous fair.

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*General observations for all  
colours.*

C H A P. XXVII.

**T**Hat 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 it's terrestriety, so that all the co-  
lours 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. Fifthly, 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.

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

C H A P. XXVIII.

**T**AKE the Scales which the Braffiers 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  
Calcar

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 serce 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 serce 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 Crystall metall,  
with the above-said scales.*

C H A P. XXIX.

**T**AKE a pot of sixty pound of Crystall  
Fritt well scummed, and not cast into  
water. I made a Sea-green without wet-  
ting the Crystall metall, and thought that it  
came out better. But we may make tryal  
of



of both ways, and stick to the best. Theri take of metall well purified the said 60 pound, and one pound and a half of the said scales made with less charges, four ounces of *Zaffer* prepared, mix well these two powders together, put them to the *Crystill* 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 *Crystill* with *Rochetta*, and you shall have a *Sea-green* every way beautiful.

---

*A Sea-green of lesser charge.*

C H A P. XXX.

**T**Ake 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

ing the rules as abovesaid in Crystall; for by this means it will receive a very fair Blew for all sorts of works, and will cost much less than Crystall: for the *Rochetta* is of much less value than the Crystall, as it is known. In this manner have I often made it at *Pisa*, and always with good success.

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

### CHAP. 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 it self without any artifice a green pale colour, this material being pulverised with the addition of *Zaffer* prepared, and with the same proportion (as is said in the other prepared Brass) the metall 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

B

*Antwerp*



*Antwerp* to the wonder of all the spectators that saw it. The manner of making *Vitriol of Venus*, without corrosives, *Spagirically*, 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.



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*A green Emerald colour in glass.*

## C H A P. XXXII.

**I**N making Green you must observe that the metall have not much salt, with metall that hath much salt as Crystall and *Rochetta* have, you cannot make a fair Green, but onely 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*, w<sup>ch</sup> will make the glass come out Yellowish, and takes away the foulness and Blewnets, which the metall always hath. This process will give the metall a fair Green. Put of thrice cal-

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 so it will to every one that shall observe punctually what is abovesaid.

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*A Green fairer than the former.*

C H A P. XXXIII.

**B**Ut 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 saltness 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.



*A marvellous Green.*

## C H A P. XXXIV.

**T**AKE 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.*

## C H A P. XXXV.

TO a pot of 10 pound of metall to wit  
half of Crystalline passed thorow wa-  
ter 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 me-  
tall into water, and take out the Lead, then  
return the metal which hath passed thorow  
the water into the pot, & let the metall pu-  
rifie for a day, then if you put in the colour  
made Chymically with the powder of the  
*Caput mortuum* of the Spirit of *Vitriollum ve-  
neris*, 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.

C H A P. XXXVI.

**P**ut 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 *Tur-*  
*cois* 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 it's  
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 shall have your desired colour. Let the Conciators well observe that this salt always crackles 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 Green of Crystal metall, and half  
Sea-green made of half *Rochetta*, which  
will become a fair colour, although it be  
not all Crystall metall.

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*The*

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*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 toys of many colours with undulations in them, and gives it an opacity such as the Natural and Oriental Stones have.*

#### C H A P. XXXVII.

**S**ince 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 publicly 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 glass 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 toys that may be made in glass, 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 glass as is required. Wherefore it is necessary that the metalls be well calcined

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, purified, 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 *Fasper* and *Agat*, and *Oriental Calcidonies*, with the fairest and beautifullest 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 glasse, 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 disjoyned 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 riseth 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.

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

C H A P. XXXVIII.

**T**Ake 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 powdred, 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, w<sup>ch</sup> 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, sitting 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 flowre and lime, of each a like quantity, powdred, 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 dried 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 glass body. And when they are well dried 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  
encrease



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 tin-  
ged with Yellow, a sign that the spirits be-  
gin to rise; continue this degree of fire un-  
till the spirits beginning to condensate co-  
lour 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,  
wh<sup>ch</sup> is known, when the head & receivers by  
little and little, begin to grow clear, and be-  
come 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 re-  
ceivers 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 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 joynts and lutings with warm water, till they being moistned 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 dregs 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 stopt 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.

## C H A P. XXXIX.

**D**issolve 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.

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How to make Aqua Regis.

## C H A P. XL.

**T**O every pound of the said *Aqua-fortis*, put two ounces of *sal Armoniack* powdered, into a glafs body, which fet in a pan full of warm water, and let the *Aqua-fortis* be often stirred, w<sup>ch</sup> will soon dissolve the *sal Armoniack* with it's heat, w<sup>ch</sup> 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 leasurely off, and in the bottom there remains the unprofitable terrestriety of the *sal Armoniack*. Now this *Aqua Regis* is strong and fit to dissolve Gold, and other metall; but silver it toucheth not at all.



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*To burn Tartar.*

CHAP. XLI.

**P**ut *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.

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F 3

How

How to make a Calcidony in Glass  
very fair.

C H A P. XLII.

**P**Ut of *Aqua-fortis*, two pound, into a  
glafs 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 bo-  
dy, and powr upon them six ounces of  
*sal Armoniack*, and dissolve it at a gentle  
heat, when it is dissolved put into the glafs  
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 Brim-  
stone,

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 several 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 bottom 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 Crystall 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 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, foot 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 toys 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 after-  
wards 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 tran-  
sparent, and no more Opacous as it ought  
to be for these works, then cease from  
working, put to it new *Tartar* calcin'd, soot  
and

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 incorporated, as 'tis usual, then work it. This was my way to make *Calcidony* in the year 1661 in *Florence*, at *Casino* in the glafs 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.

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The second Calcidony.

CHAP. XLIII.

1. **I**N 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 *Aqua-fortis*, and therein dissolve one ounce of *sal Armoniack*, and in the dissolution of crude *Antimony* powdered, *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 *Aqua-fortis*, two ounces of *sal Armoniack*, then put in one ounce of *Zaffer* prepared, and a quarter of an ounce of *Manganese* prepared, and half an ounce of thrice calcin'd Copper, and one ounce of *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 *Aqua-fortis* two ounces of *sal Armoniack*, and then add of *Cerus*, Painters Red-lake, *Verdigreas*, the Scales 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 penetrate & subtilise the ingredients and metall, 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 joyn the head & receiver & lute the jonts (as is usual) and the water being evaporated, there remains at the bottome 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 Crystall, 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 foot of the Chimny *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 opacity, and if it shew the variety of colours with toys and wavings, work all of it into vessels of divers sorts, framing therewith all sorts of workmanship, and variety of toys.

With this sort of *Calcidony*, I made many 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*.

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The third way of Calcidony.

## C H A P. XLIV.

1. **I**N a glafs body in ftrong *Aqua-fortis*,  
dissolve four ounces of fine leaf Sil-  
ver, that is to say, round cuttings of leaf  
silver, stop the body and set it aside.

2. In another body of like glafs dis-  
solve in one pound of *Aqua-fortis* five  
ounces of *Quick-silver* purified with vine-  
gar and common salt, in a wooden dish  
with a wooden pestle stir the *Mercury* suffi-  
ciently round with ftrong vinegar, and wash  
it with clear common water, until 'tis dis-  
solved, 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 glafs vessel, and set it a-  
side.

3. In another glafs 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 terrestriety, by dissolving it in common water, and boyling it a little, and then let it settle two dayes that the terrestriety mixed with the salt may sink to the bottome, then filtre the water, and in the bottome will remain the grosness and terrestriety of the salt, evaporate this water filtered from the terrestriety of the salt in a glasse 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 bottome calcin'd and powdered, and add unto it it's weight of new common salt prepared (as before) mix them well, and put all in a chrysole 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 saltness 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 bottome cast away. In his 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) leasurely 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 gently each of them (ground by themselves)

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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 leasurely 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*, whereto put of *Verdigreas* one ounce, Red-lead, crude *Antimony*, and the *Caput mortuum* of *Vitriol* purified, of each half an ounce, put these powdered leasurely in, close the vessel, and set it aside.

9. In another body, dissolve in a pound of *Aqua-fortis*, two ounces of *sal Armoniack*, then put in leasurely *Orpiment*, white *Arsnick*, Painters Lake, of each half an ounce, each powdered, and ground by it self, close the vessel, and set 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 work 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 (whereinto you have powred the materials of all the lesser bodies) closed for six dayes, 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 bottome, 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 so the powder will work fair, and strange things in glafs. In the bottome of this body, will remain a powder of a purplish Green, whereof I gave the glafs 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 it's body, to wit, *Tartar* burnt, the soot of the Chimny, and *Crocus Martis* made with vinegar, using the same dose, and diligence, times, and



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 *Portughes*, 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 Ghiridolpho* a very Courteous Gentleman to work, which *Calcidony* came forth so fair, and beautiful, that it imitated the true *Oriental Agat*, and in fairness and beauty of colours far surpassed it. Many *Portughes* 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 although

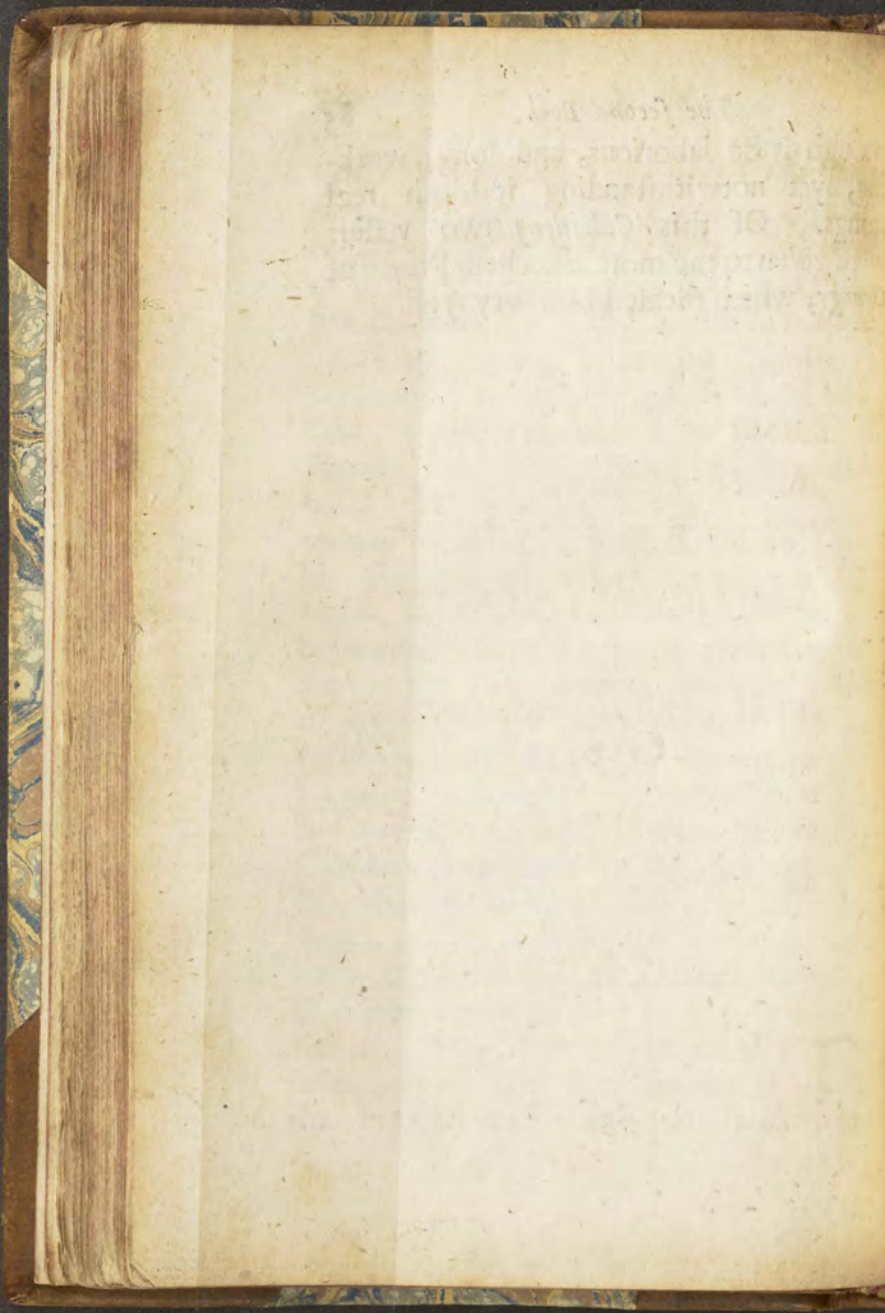
though it be laborious, and long a working, yet notwithstanding it doth real things. Of this *Calcidony* two vessels were given to the most Excellent Prince of *Orange*, which pleased him very well.

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*The*

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*The third Book. This Book shews the wayes to make the colour of Gold Yellow, of the Amethist, 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.*

CH A P. XLV.

**T**His 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, sercing, 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 Picmont.

4. The

4. The colour must be made fuller or lighter according to the works you employ them for, and to brighten them, put in more of the colour, but to make them lighter, put into the pot more Fritt. Take some metall 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 metall, when melted, for then it neither takes the colour so well, nor so good a colour.

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

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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 serced 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.*

## C H A P. XLVII.

**T**Ake of Crystall and *Rochetta Fritt*, of each a like quantity, mix them well, and to every 100 weight, add of *Manganesse* 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 *Manganesse* 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.

*Amethyst*

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*Amethist colour.*

## C H A P. XLVIII.

**T**Ake onely *Crystal Fritt* made with the most perfect *Tarso*, *Manganese* prepared one pound, *Zaffer* 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.

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*Saphyre*



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*Saphyre colour.*

C H A P. XLIX.

**T**O 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.

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*A fairer Saphyre colour.*

C H A P. L.

**I**Nstead of *Rochetta Fritt*, take *Crystal Fritt*, whereto add the same quantity of the foresaid powder, with the same rules, and you shall have a fair, and shining *Saphyre* colour.

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*A Black colour.*

C H A P. LI.

**T**Ake 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.

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*A much fairer Black.*

## C H A P. LII.

**T**Ake of the *Frits* of Crystal and *Polverine*, of each 20 pound, Calx of Lead, and Tin four pound, mix all together, set 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.

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*Another*



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*Another fairer Black.*

CHAP. LIII.

TO a hundred weight of *Rochetta Fritt*,  
give two pound of *Tartar*, and of  
*Manganesse* six pound, both pulverised,  
mix them and put them in the furnace  
leisurely, 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.

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*A fair milk White called  
Lattimo.*

## C H A P. LIV.

**T**Ake 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.

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*A fair White much whiter than the former.*

CHAP. LV.

**T**AKE 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*.



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*To make a Marble colour.*

C H A P. LVI.

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

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*A Peach colour in White.*

C H A P. LVII.

**M***Anganese* prepared will make in Lattimo the colour of a Peach-flower. But work it in time because it loseth colour.

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*A Deep Red.*

## C H A P. LVIII.

**T**Ake 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 leasurely 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 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 it will lose its 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.

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Fritt of natural Crystal.

CHAP. LIX.

**C**alcine natural Crystal in a Chryfible, extinguish it in common cold water eight times, cover the Chryfible that no ashes nor filth get in, Dry the calcined Crystal, and grind it to an impalpable powder, mix this powder with salt of *Polverine* 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.

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*A Pearl colour in Crystal.*

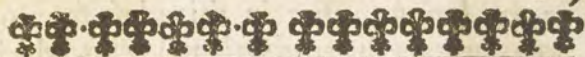
C H A P. LX.

**P**ut 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.

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*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.

**T**He 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  
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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.

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*To calcine Lead.*

## C H A P. LXII.

**A**T 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 onely 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 declivitie 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 serce all in a fine serce, and what passeth not the serce 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.*

C H A P. LXIII.

**T**Ake of this calcined Lead 15 pound, and Crystall or *Rochetta* or *Polverine 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 metall into the pot, which in 12 hours at most you shall have most fit to work.

*The manner how to work the said  
glass.*

C H A P. LXIV.

**T**O 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 its self. 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



'tis impossible to work it. Which proceeds from the calcined Lead, which makes it most tender as a caudle.

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*Glass of Lead of a wonderful Emerald colour.*

CHAP. LXV.

**T**AKE of *Polverine Fritt* 20 pound,  
 Lead calcined 16 pound, serce 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 co-  
 lour, and in few hours 'twill run and be-  
 come very clear, then give it brass thrice  
 calcined (made as in Chap. 28.) six oun-  
 ces,



ces; and therewith mix a peny weight of *Crocus Martis* made with Viniger, put in this mixtute at six times, alwayes mixing well the glafs, and taking at each time the intervall of saying the Creed. Let this glafs 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 glassses, which will appear in a colour proper to the Emerald of the old Oriental rock, with natural shining and glittering.

Let this glafs 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.

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Another

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*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.

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*Topaz colour in glass of Lead.*

C H A P. LXVII.

**T**Ake Crystal *Fritt* instead of *Polverine*  
*Fritt* 15 pound, Lead calcined 12  
pound, mix and serce them both together,  
set them in the furnace not too hot, at the  
end of 8 hours, cast them into water, se-  
parate 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 Ori-  
ental Topaz.

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*A Sky or Sea-green in glass of Lead.*

C H A P. LXVIII.

**T**Ake Crystall *Fritt* 16 pound, Lead  
calcined 10 pound, mix and serce 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 *Zaffer* 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.

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*The colour of a Grandt in glass of Lead.*

CHAP. LXIX. 121

**M**LX 20 pound of *Crystill Fritt* with 16 pound of calcined lead, serce and put them into a pot, and to them of *Manganese* three ounces, of *Zaffer* 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.

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*Saphyre colour in glass of Lead*

C H A P. 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.

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*A Yellow Gold colour in glass of Lead.*

C H A P. LXXI.

**T**Ake of Crystall *Fritt*, and calcined lead, of each 16 pound, mix and serce them well, and add to them of Brass thrice burned 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, set 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.

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*The colour of Lapis Lazuli.*

C H A P. LXXII.

**M**Elt 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*.

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

C H A P. 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 Chryfible that will bear the fire, and above this mixture the Crystals in pieces, then cover this Chryfible 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 smoak much, do this operation in a large Chimney, and avoid the dangerous and deadly fumes, when all these fumes are gone, let the Chryfible stand till the pot cool, and the fire go out of its self. Then unlute the Chryfibles, and take out the pieces of Crystall, and those which are at the top will be tinged with a good Yellow colour, with a red Rubie, and Balafs colours with fair spots, those which lay at the bottom upon the powder, and the residue 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 shewing beauty, such as is in the Topaz, Rubie and Balafs, if you give them foils suitable to their colour they make a fair shew, being set in Gold. Of these Crystalls 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 beauriful and fair.



The colour of a Balass, Rubie,  
Topaz, Opal, and Girasole in Na-  
tural Crystall.

C H A P. 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 Chryfible, and upon the pow-  
der, 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 plea-  
sing thing, let them be very large. And so  
fill the Chryfible, to which lute well ano-  
ther 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  
pafs thorow the pieces of the Crystall.

I 4

Which



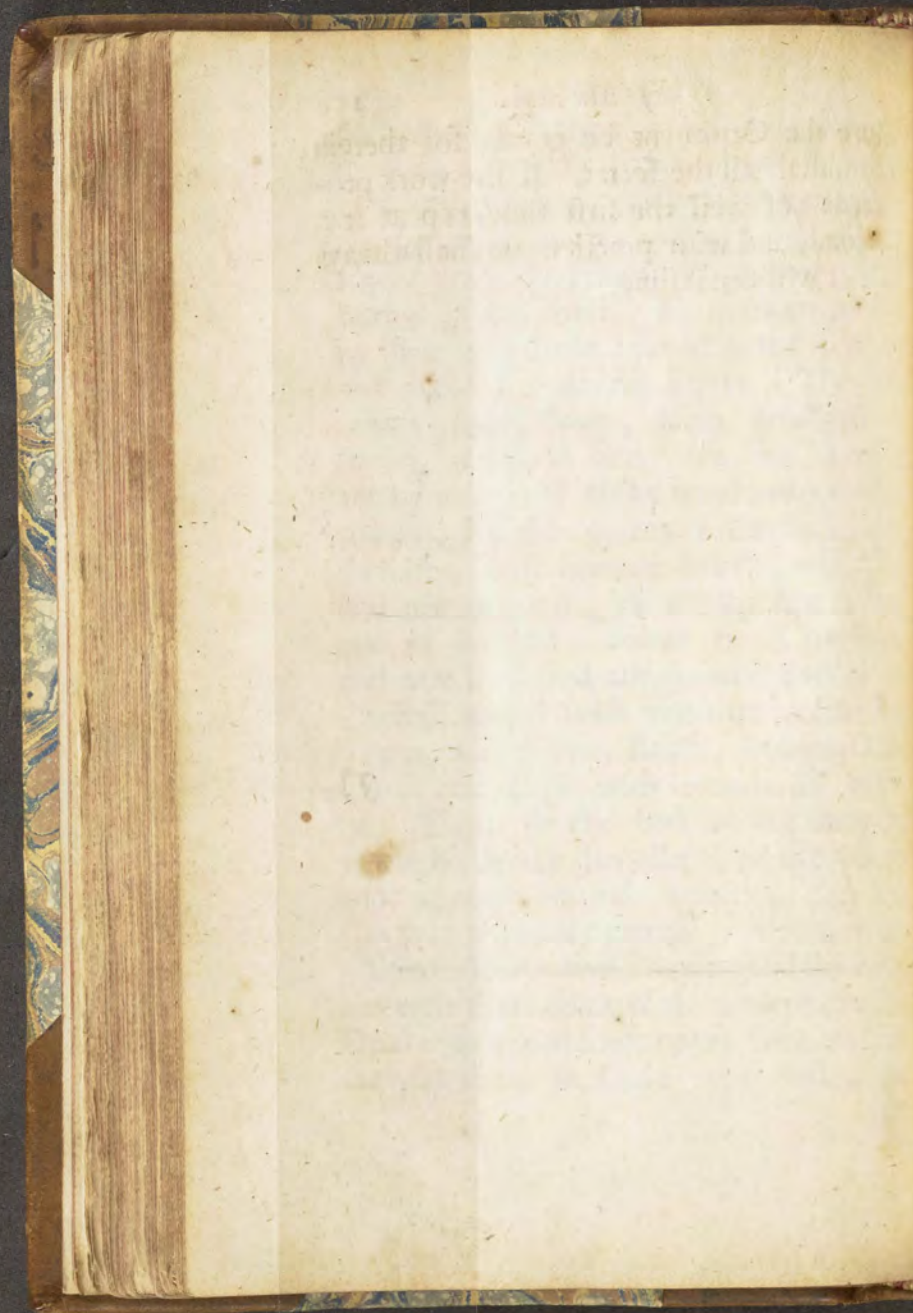
Which tingeth the Cryftall well, and better than when they pafs thorow the joynts of the Chryftibles. When the lute is dried, fet them in the coals, fo that all the lower moft, and half the uppermoft be buried in the coals. Then kindle the fire by little and little, do as in the former, and avoid the deadly fumes. The materials fume long, keep constantly a ftiong, and good fire. See you let not in any wind or cold air by windows or other places, for the pieces of Cryftall being then hot, will become brittle, will fplit, and not be good. When the fire is gone out of it's felf, unlute the Chryftibles, and you fhall find the greateft part of the Cryftall tinged with the true colours of Topaz, Chryfolite, Balafs, Rubies, Girafole, and Opal with wonderful beauty. Thofe of the beft colour may be wrought by the Jewellers, at the wheel, and appear natural jewels, and the Cryftall holds it's natural hardnefs, which is great. At *Antwerp* I made good ftore, and amongst them, fome of them were of a fair Opal colour, and fome of the Girafole. You may fet them in Gold with foiles. Be  
fure

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.

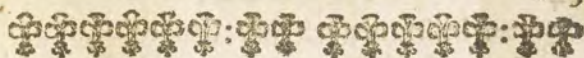
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*The*







The fifth Book. *Wherein is shown the true way to make pasts for Emeralds, Topas, Chrysolite, Iacintb, 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 excellling all other pasts that have been hitherto made, both in beauty & colour.*

C H A P. L X X V.

**I** Believe there are few who desire, and seek not with all earnestness the knowledge

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 parts 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.

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The way to prepare natural Crystall.

## C H A P. LXXVI.

**T**Ake natural Crystall 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 Crystall 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 Crystall 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 Crystall, put them in Chrysbles covered at the top, set them in burning coals till they be both well heated & fired, then suddenly cast the Crystall into a very large pan, full of cold clear water. When the Crystall is cold recal-

cine



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 Chrysilbe, and that the water be always very clean. When the Crystall is well calcin'd 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 sencing 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 dirty 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 Artificiall jewels, and shall be called hereafter Crystall prepared.

*These*

*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 Cry-  
stall is calcin'd, and wherein the pasts are  
baked with lute well dried, 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 sufficient-  
ly baked the first time, bake it again a se-  
cond 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  
plisters.

6. Leave the vacuity of a fingers thick-  
ness in the top of the pot, especially where  
'tis said it swels 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*



*How to make Oriental Emeralds.*

## C H A P. LXXVII.

**T**Ake of Cryſtall prepared two ounces, ordinary Red-lead four ounces, mix and incorporate them well together, good *Verdigreas* two penny 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



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.

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To make a deeper Emerald colour.

C H A P. LXXVIII.

**T**Ake 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.

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To make a more beautiful past for Emeralds.

CHAP. LXXIX.

**T**Ake 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.

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*Another,*

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*Another most fair Emerald.*

CHAP. LXXX.

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

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*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.



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*An Oriental Chrysolite.*

C H A P. LXXXII.

**T**Ake of prepared Cryftall 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.

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*Sky colour.*

C H A P. LXXXIII.

**T**Ake of Cryftall 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.

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*A Sky with a Violet colour.*

C H A P. LXXXIV.

TAKE of Cryftall 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 paff will be a moft fair Violet, and pleafant Sky-colour.

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*An Oriental Saphyre.*

C H A P. LXXXV.

TAKE of Cryftall prepared two ounces, ordinary *Minium* fix ounces, mix them well, & add of *Zaffer* prepared five grains, mix with the *Zaffer* of *Manganeſe* prepared feven grains, remix and bake them for an Oriental Saphyre, which will have a moft beautiful Violet colour.

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*A deep coloured Oriental Saphyre.*

C H A P. LXXXVI.

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

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*An Oriental Garnat.*

C H A P. LXXXVII.

**T**Ake of Cryſtall prepared two ounces, ordinary *Minium* ſix ounces, mix them and add about 16 grains of *Manganefe* prepared, wherewith mix three grains of *Zaffer* prepared, mix them all together, and bake them for a moſt fair & ſightly Garnat.



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*A Deeper Oriental Garnat.*

## C H A P. LXXXVIII.

TAKE of Crystall prepared two ounces, ordinary *Minium* five ounces and a half, of *Manganese* prepared 15 grains, wherewith 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.

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*Another fair Garnat.*

## C H A P. LXXXIX.

TAKE of Crystall prepared two ounces, ordinary *Minium* five ounces, mix them, and add 52 grains of *Manganese* prepared, wherewith 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.

C H A P. X C.

**O**Bserve, that the colours in the aforesaid pasts, 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 onely colours from *Verdigreas*, *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

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.

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

C H A P. XCI.

**T**HIS 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 Cerufs, 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 swels, 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 leasurely the Vineger coloured enough, and impregnated with salt, which set aside in a glass vessel, then pour more fresh distild Vineger on the Cerufs, and evaporate and decant as before. Repeat this till you have extracted all the salt from the Cerufs, 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 glased 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 serced wheaten flour. This is call'd the true Sulphur of *Saturn* purified from all terrestriety, foulness, and blackness which *Saturn* had at first in it self. 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



far surpasses 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.

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How

How to make very hard past of all colours.

C H A P. X C I I.

**T**AKE 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 glased 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

more<sup>a</sup>

moreover this sort of purest glafs will be tinged into all colours you desire. For example into an Emerald with Brass thrice calcin'd, as is done in ordinary glafs, 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 w<sup>th</sup> *Tartar* & *Manganese*, putting them in by parts, and into a Garnat 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.

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...the first book  
...will be  
...For ex-  
...things  
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*The sixth Book. Wherein is shown 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.*

**E***Namelling on Gold and other metalls is a fair and pleasing thing, and in it's self not only laborious, but necessary, since we see metalls 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-*  
I
ing

ing to me to be a thing grateful and pleasing to all, I set my self to describe many ways to make several sorts of Enamels, as a thing not vulgar, and belonging to this Art, and one of it's 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.

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*The Material wherewith all Enamels are made.*

C H A P. XCIII.

**T**Ake of fine Lead 30 pound, of fine Tin 33 pound, Calcine them together in a Kil, and serce 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 Crytal Fritt made with *Tarso*, ground and serced fine, of each 50 pound, of white salt of *Tartar* eight ounces, powder, serce 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 glased 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 tonges for the Goldsmiths use.
4. The way to make Enamels is this,  
L 2 powder,

powder, grind, and serce 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.*

C H A P. X C I V.

**T**Ake of the stuff for Enamels six pound, of *Manganese* prepared 48 grains, cast it thrice into water when refined and melted.

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*An Enamel of a Turcois colour.*

## C H A P. X C V.

**T**Ake 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 *Manga-*  
*nese* prepared, mix them well and put  
them into the stuff at four times, mixing  
them well every time, let them incorpo-  
rate, 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.*

## C H A P. X C V I.

**T**Ake 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.

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*A Green Enamel.*

## C H A P. X C V I I.

**T**Ake 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 it's 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. XCVIII.

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.

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*Another Green Enamel.*

CHAP. XCIX.

TAKE of the stuff for Enamels four pound, which in few hours will be refined, then cast it into water, and put it  
L 4 again

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.

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*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*



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*Another Black Enamel.*

C H A P. C I.

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.*

C H A P. C I I.

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 metall's ordinarily.

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*A Red Enamel.*

CHAP. CIII.

**T**O 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.

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*A Purplish Enamel.*

C H A P. C I V.

**T**Ake 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.*

C H A P. C V.

**T**Ake 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 fur-  
nace in a large pot, when refined cast them  
into



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.

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*A Sky coloured Enamel.*

C H A P. CVI.

**T**AKE 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,

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*A Violet colour'd Enamel.*

C H A P. C V I I.

**T**Ake 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.

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The

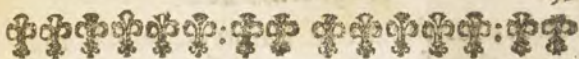
A Violet coloured Elixir

CHAP. CVII.

Take the ground of the fluff for Elixirs,  
 of Marjoram, prepared, three ounces, of  
 white, black & red 48 grains, mix these  
 two powders well together, then mix  
 them with the fluff for Elixirs, put them  
 into the mortar, and cast them into water,  
 put on them the linnen again, and do as  
 before.

The





*The seventh Book. Wherein  
is shown the manner how to  
extract Yellow Lake for  
Painters, from Broom flow-  
ers, 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 transpa-  
rent Red, and a fair Red to Enamel upon  
Gold and Metalls, things neither Vulgar  
nor common.*

**I**N this Book is shown the way to ex-  
tract 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.

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*A Yellow Lake to Paint, from Broom Flowers.*

C H A P. CVIII.

**M**Ake 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

M

bottom.



bottom. Repeat this process, until you perceive the water run out sweet and without saltness 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 cloath, 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.

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

C H A P. C I X.

**G**ET what quantity of the leaves of Flowers of what colour soever they be, let every colour be by it self, 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-Flowers,  
 from all Flowers whatsoever,  
 and green from Mallows, Pimper-  
 nells, and all other Herbs.

## C H A P. C X.

TAKE of whatsoever Herb, or Flower,  
 of whatsoever colour you will, which  
 being bruised green upon a leaf of white  
 Paper, tinges it with it's colour, these are  
 good, but the Herbs and Flowers which  
 do not so, are not good, then put into a  
 glass body ordinary *Aqua vite*, the head  
 must be as large as possible, and in the  
 top thereof put the leaves of whatso-  
 ever Flower or Herbs, from which you  
 would draw a tincture, then lute the joynts  
 of the head, and thereto fit a receiver, then

M 2

give



give a temperate heat, that the thinner parts of the *Aqua vite* ascending to the head, and falling upon the leaves and Flowers, may suck out the tincture, and distill thence into the receiver coloured Red, and full of the tincture of the Flowers, making all the subtile part of the *Aqua vite* to ascend so long as it comes coloured, and then distill this *Aqua vite* 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.

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*A Blew to make.*

C H A P. CXI.

**T**AKE 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.

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How to colour natural Turcoises discoloured.

CHAP. CXII.

**P**ut Turcoises discoloured, 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.

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*A mixture to make sphears.*

## C H A P. CXIII.

**T**Ake of Tin well purified and purged, three pound, Copper well purified one pound, melt these two metalls, first the Brass, then the Tin, and when they are well melted cast upon them six ounces of *Tar-tar* of Red wine onely 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 sphear, and you shall have a good material, the which you shall cause to be burnt and polish'd, which will shew well, and this is the mixture called steel to make sphears.

*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.*

## C H A P. CXIV.

**T**Ake 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 stick in waves, within the Ball. Then do the same with Verdigrease, 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 suddainly 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 dried) stick so that afterwards they will not fall off, and alwayes 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.*

## C H A P. 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 Chryfible, 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 afore-said 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 glased 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 glased and cleaned. This casting on of warm water upon the  
the



the pastils, must be repeated till it be no more coloured, but observe that the water be not over hot, but luke warm onely, 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 beautiful *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 powder

der on a Porphyrie ( as is abovesaid ) and  
 'twill arise most beautiful. If you take  
 common Blew smalts ground on a Por-  
 pyrie to an impalpable powder, and  
 incorporate it with the gumm pastils with  
 the foresaid quantities, keeping them in-  
 digestion in cold water 15 days with *Lapis*  
*Lazuli*, and work thorowout as in *Lapis*  
*Lazuli*, you shall have a very fair and sight-  
 ly Blew Bice, which will seem to be an *Ul-*  
*tramarine*. These Blews not onely serve  
 for Painters, but to colour glafs excel-  
 lently.

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*A Lake from Cochineel for Painters.*

C H A P. CXVI.

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

Take four ouaces of Roch-alum, two  
 70b 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.

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*A Magistery to extract the colour from  
Cochineel.*

C H A P. CXVII.

**C**old water four gallons, wheaten bran four pound, *Saline* of the *Levant*, *Fenugreck*, 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 *Magistrie* for use.

Put into a clean pipkin three gallons of  
cold



cold water, and one of the said Magistery, when it boils, of Cochineel powdered, after this manner, in a Brasse Mortar, powder and serce one ounce of Cochineel, so many times, till all pats the serce, 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 serced, and as soon as the water in the pipkin boils put in the Cochineel, and let it colour the water whilst you can say a *Miserere*.

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 set it to dry in a place where no dust falls, spread it a  
broad

broad that it may not become musty, and heat again. Take heed that the fire be always very gentle, for with too 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 liquour 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 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 *Hyprocras* 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 drayned, 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 glats 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 neer out, if happily any strain through somewhat coloured, pour it again into the bag, and then this second time 'twill leave all the tincture



ture 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 readines new baked bricks, where on spread little pieces of linnen, and on the linnen 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 linnen, 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.

N

Lake

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*Lake of Brasil and Madder very  
fair.*

C H A P. CXVIII.

**I**F 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*

*Lake from Cochineel after another and more easie manner.*

C H A P. CXIX.

**I**N 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 *Aqua vite* 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 *Aqua vite* 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 *Aqua vite* coloured with

N 2                      Cochi-



Cochineel, and put this into the *Hypocras* 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*.

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*A transparent Red in Glass.*

C H A P. C X X.

**T**Ake *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 it's saltness, the salt being separated, dry it, and it will be of a Red colour, hereto add it's 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 residue, 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 Crystal 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.

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*A Red as red as Blood.*

## C H A P. C X X I.

**P**ut six pound of glass of Lead, common glass ten pound, into a pot glassed 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.

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*The colour of a Balass.*

## C H A P. CXXII.

**P**ut 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 glafs become purple, and this you shall do eight times, and know that Alum makes the glafs grow Yellow, and a little Reddish, but not blakish, and it always makes the *Manganese* flie away; and the last time that you add *Manganese*, give not the glafs more Alum except the colour be too full, and so you shall have a most fair *Ballas* colour.

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To extract the *Anima Saturni* which serves for many things in Enamels and glasse.

C H A P. CXXIII.

**P**Ut Litharge well ground into an earthen pan well glased, 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 glased 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 glasse 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 bottom,

rom, 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.

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*A fair Red to Enamel Gold.*

C H A P. C X X I V.

**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



do this twice, then put them in the furnace, and when well refin'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.

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*A fair Red for Gold after another Manner.*

C H A P. C X X V.

**T**AKE Crystall *Fritt*, made as in Chap. 124. four pound, melt it in a clean pot glased, 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 Hematites*, 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 Hematites*, 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.

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*To fix Sulphur for the work above-  
said.*

C H A P. CXXVI.

**B**Oil Flowers of Brimstone in com-  
mon oil an hour, take them from the  
fire, and cast upon them the strongest Vi-  
negar, and the Sulphur will suddainly sink  
to the bottom, and the oyl will swim upon  
the Vinegar, empty the oyl and Vinegar,  
and put new oyl upon the Sulphur, repeat  
this thrice, and then you shall have a fixed  
Sulphure, for the work abovesaid.

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*Glass as Red as blood which may serve  
for the abovesaid fair Red.*

C H A P. CXXVII.

**M**Elt 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, w<sup>ch</sup> 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*

[An approved way to make a fair Red  
Enamel for Gold.

C H A P. CXXVIII.

**T**Ake of Cryfall *Fritt*, boil it as in Chap. 124. six pound, refine it well in a glased 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 foot 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 glafs at four times, mixing them well, and interpose a little space between each time, for they make the glafs swell and boil exceedingly, when all the powder is put in, let the glafs refine three hours, then remix them, and take a proof, to wit, a little Bowl of glafs, 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 Martis*, by little and little, till it come to the desired colour, let the glafs 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*.

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*A transparent Red.*

## C H A P. CXXIX.

**C**ALCINE 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 Crystill glass which hath been often cast into water, will make the transparent red of a Rubie as by experience is found.

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*The way to fix Sulphur for a Rose-  
Red to Enamel on Gold.*

C H A P. CXXX.

**M**Ake a strong Lee of Lime, and Oaken ashes, boil sufficiently Sulphur in this Lee, which takes away a certainunctuous and combustibile colour which Sulphur hath in it; by changing the Lee the Sulphur becomes white and incombustibile and fixed, good to make this Rose-red for the Gold-smiths to Enamel upon Gold.

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Vitriolum

*Vitriolum Veneris which was begun at the end of 31 Chap.*

C H A P. CXXXI.

**S**ET 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 it self, then take out the Chryfibles, and you shall find the Copper calcin'd to a blackish colour, having an obscure purple, which powder, and serce 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 acrofs, fill the pans with kindled coals, and put in the aforesaid calcin'd Brafs, wherewith you have first mixed to every pound weight there of six ounces of common Brimstone powdred, & 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 hooch at the top, that it may not stick, nor cleave to the pans; continue  
this



this till all the Sulphur<sup>r</sup> 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 mortar, 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. Ob-  
serve, 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 a-  
bout to say.

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*Vitriolum Veneris without Corrosives, from which is extracted the true and lively Blew, a thing marvellous.*

## C H A P. CXXXII.

**T**O make then the *Vitriolum Veneris* above said, take one or more very capacious Glafs 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

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 bottome in a Red substance, then Filre the said water with usual linguets into glafs vessels, and evaporate from the said Copper all the moisture, and with six ounces of Sulphur calcined, powder and serce 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 serced, 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 proces not onely 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 Filtréd waters, all which mixed



together must be Filtred with the usual liquets, and the setlings and dregs may be cast away as unprofitable, then you shall have a most limpid water, and coloured with a most marvellous blew colour.

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

C H A P. CXXXIII.

**S**Et 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 tincture, which put into earthen

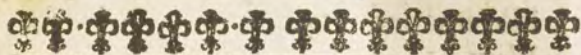
earthen glased pans in a cold and moist place for a night, and you shall finde the Vitriol shot into points like Crystals, which will appear like true Orientall Emeralds, decant oft all the water that is in the pans, dry the Vitriol, and let it not stick to them, then evaporate half this water, which 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 w<sup>ch</sup> 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 marvellous things are done, as you may well perceive by it's 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,

F I N I S.





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Observations on the Epistle  
to the Reader.



*Concerning our Authour, 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 Bor-netius 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 Spagyricall 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 kinde 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 uselesse, or indeterminate, most of whose notions were bare λογουαχιαί. But our most learned Bacon, a  
man*



man of a most sublime, and piercing intellect, in his incomparable *Novum organum*, hath fully confuted & shewed the vanity & in efficacy of that other way, and hath more wisely substituted another more effective 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 convene 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 tryal and invention, with all the circumstances thereunto 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 inficiunt*, all the Britans colour themselves with *Glass*, & *Mela*, lib. 3. cap. 6. *Britanni vitro corpora infecti*, and *Vitruvius*, wooll died with *Glass*, for so the learned *Turnebus* restores 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 *Selinutia 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 Apesion Itali alutam alii herbam vitrum*, which is to be written, *Isatis alii Angionen Prophetæ Arosion Itali rutam alii herbam vitrum*. *Salmatius* ever fastly puts *Guastum* for *Glastum*, because the Britans continually call it *Guadam*, 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-*

Britannorum conjuges nurusque toto corpore oblitæ quibusdam in sacris nudæ incedunt. *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 Britans 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 Phyſicians, 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 wholly 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 vitrify and turn to glass. Which would be true upon supposition of a proportionable mixture of fit Salts, and Sand or Stones.

'Tis much like all sort of mineral or middle mineral. I find Authors differ much about referring Glass to it's Species. Agricola, lib. 12. de Metallis, maketh it a concrete juyce, Vincent Belluasensis, lib. II. 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

P,

ask-



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 proper 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 discovereth Metalls by it's innate energie of separating heterogeneous bodies and congregating homogeneous: 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

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  
 reduced from the smallest and inmost particles  
 of the Glass-stone, that is, of it's proper Me-  
 tall; so far he. 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 a-  
 bove 150 of Metall; besides, the Salts compo-  
 sing 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 tast;  
 furthermore in the finest Glasses, wherein the  
 salt is most purified, and in a greater propor-  
 tion 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 rea-



son of that saying, that Venice Glasses will break with poison, which is true of some Mineral, but not of Vegetable or animal poison. All which manifestly evince that salt remains in the Glass in specie. Add hereunto that experiment of Helmont, Cap. de terra, who thus saith, Si vitri pollinem pluri alkalis colliquaverit ac humido loco exposuerit, reperiet mox totum vitrum resolu in aquam, cui si affundatur Chrysulea, addito quantum saturando alkali suffecerit inveniet statim in fundo arenam federe eodem pondere quæ prius faciendo vitrum 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 presently settle to the bottom in the same weight which was put in at first.

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

A second general argument is this, that though the said concrete juyces stones and  
Glasses,



*Glass, may have fusion in the fire, yet neither all stones, nor all concrete juyces, Metalls, nor Semimetalls have fusion, such are Talc and English Spaud, sal Armoniack, Tincal, &c. Reckoned amongst concrete juyces; nor Diamonds, Cats-eyes, Agate, Jaspers, nor most other pretious stones, nor Marble; Nor many other stones wherewith the inside of these furnaces are built. Neither can Mercurie amongst Metalls be said to melt, nor amongst the middle Minerals Orpiment; and though most of them have fusion, yet none of them have ductilitie, but Metalls onely, and they onely 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 aforesaid 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 it self, 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*

of glass, as Vitrum Antimonii, Moscovie glass, and bricks or other stones vitrified, neither whereof will bear this tryal. which rather have their denomination from their transparency, (as Vitriolum too hath a Vitro) than from their intrinsecal nature and properties. 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.
- 3 When melted 'tis tenacious and sticks together.
- 4 It wasts not nor consumes in the fire.
- 5 'Tis the last effect of the fire.
- 6 When melted it cleaves to Iron, &c.
- 7 'Tis ductile whilst red hot, and fashionable 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.



- 11 'Tis flexible and hath in threeds momentum restitutionis.
- 12 Cold and wet disunites and breaks it, especially if the liquors be saltish, and the glass suddainly heated.
- 13 It onely receives sculpture, and cutting, from a Diamond or Emery stone.
- 14 'Tis both coloured and made Diaphanous as pretious 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 sit 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.



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 musty, 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.

**C**oncerning the Antiquity of Glass, our Author here fetcheth it from Job Chap. 28. v. 17. Who in this Chapter from v. 15. to the 20<sup>th</sup> compares wisdom to the choicest things; and in this 17<sup>th</sup> v. saith, Gold and Glass shall not be equalled to it. So our Author from the Vulgar Latine translation, the Septuagint, Hieron, Seres, Elias in 10 Menclatore. Hieron. Pineda, Biblia Tigurina, & Syriac, but lacinth in the Arabick translation.

Cryfall, Chaldee, Santes, Arias Montanus,

tanus, Forsterus. *The Hebrews whom Nicetas follows, and the King of Spains edition, and so the English translation.*

A stone more pretious than gold, as Fagninus 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 Crystall, Vitrum CrySTALLINUM, Complutensis.

A Peril, as Vatablus.

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

A Pyropus or Carbuncle, or some such neat and precious Gemm, as others, so Pinceda: 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



is rendred by the Septuagint, Pellucid, Hence 'tis manifest why so many rendrings of the text, since the word in general signifieth onely 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 Brest-plate, Exod. 28. and this word here not to be found in that Chapter. Nor Glas 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 subjoynd to Gold, was added after it for amplification. Add hereunto, that Glas 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 messe alienâ.

Aristophanes seems to be the first that mentions this word  $\Upsilon\alpha\lambda\alpha\sigma$ , now rendered Glass; for in Nubibus, Act. 2. Scen. I. he brings in Sthrepfiades 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  $\Upsilon\alpha\lambda\alpha\sigma$ . Whereon the Scholiast thus, Druggists sold precious stones as well as Medicaments. And that the Antients call'd  $\chi\rho\acute{\iota}\sigma$ , (the same with  $\chi\rho\acute{\iota}\varsigma\alpha\lambda\alpha\sigma$ ) 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  $\Upsilon\alpha\lambda\alpha\sigma$ , in this sense, but Hyalen, Hyalon, Hyaloen, shining and Diaphanous.

nous. The Etymologist hath it in this sense and fetcheth the Etymon from *ἕβη*, 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 Aristotels (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 abovesaid. And note the ambiguity of the word *Ἰαλός*, 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 saith, 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 saith, 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,  
and



and again, to break the Body of the Glass; And Lucian mentions very large drinking vessels of Glass. And Plutarch in his Sympoliack, 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 no body 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.

— nisi recta foramina tranant  
Qualia sunt vitri, l. 4. 602, 603. and again,  
Atque aliud per ligna, aliud transire per Aurum;  
Argentoq; foras, aliud vitroq; 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,



*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 Antients, and must needs be as Ancient 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 superficially 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 nature 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 Colophonia, 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



Bricks usually *Vitrifie*. But I have not heard nor seen any of them *Vitrified* in the firing of houses built therewith. For it seems that onely 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, putrifies 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 *Kali* in Spain and Egypt, for *Barillia* 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 *Tubalcain* 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.

Amongst



Amongst those Chymists, the most antient seem to be Egyptian Princes, who all from Hermes Trismegistus downwards professed this art, endeavouring 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 materialls 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 Glafs.

**I**N Domestick affairs it makes drinking vessels, infinite in fashion, colour, largeness, the Romer for Rhenish wine, for Sack, Claret, Beer,

Q

*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 liquours, the clearness and goodness of them. Besides dishes to keep and to serve up sweetmeats, 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 Engravers, 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



*in the Vulgar beholder, as you may see in Schottus Opticks, Catopticks, Catoprocousticks, Catoptrographicks, Dioptricks, and Telescopicks, 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.*

*Iove saw the Heavens fram'd in a little glass,  
And laughing, to the Gods these words  
did pass,*

Q 2

Comes



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 *Syracusan* brings  
 Hither by Art ; Spirits inclos'd attend  
 Their severall Sphears, and with set moti-  
     ons 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 af-  
 fections 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 ra-  
 refaction and condensation, in Thermos-  
 copes, 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 forein 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 Ta-*



*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 seem'd 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 onely, 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 passed 'twould be less esteemed by that Emperour. But afterwards when he knew that such a gift had been presented to the King,*  
and



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 Emperour, 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 metallis 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 Emperour 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 *Cæsar* 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 banished him the City, but he returning (as a supplicant) to

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 chafe 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, Cæsar 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, Pancirolus and others follow, onely telling it as a hear-say; but Mathesius, Goclenius, Valensius, Quatriami, Libavius, and all the tribe of the Chymists, assert it with great confidence, 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 scrunt, they report, and with a fama, the report was, and thirally, crebrior quam certior, more



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 *serunt*, and hereby sufficiently have provided for his reputation, but he superadds *de proprio, fama crebrior, &c.* which at most proves onely 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, 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 Emperour 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 onely. All then was but *vox populi* and *Romani* too, nay, of the cruelty



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 rendred 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 onely 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 Cæsars words. But so much of Plinys 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 Plinys text the words will not bear, and have with additionals moulded it into a formal relation.

lation. Pliny saith, ut flexible 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 oiber 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 it's self 'tis apparent, for fine Crystall 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,



periment, 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 where as 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, whereof Virgil, *parva metu primo mox sese 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 quite  
other-



otherwise, for 'tis of it's own nature the most brittle thing in the world, and to make it malleable, a quality quite contrary to it's nature must be introduced. Besides diaphaneity is a property not communicated to any thing 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 hereunto, 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. Salt-peter, 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

*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.*

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of the mouth of the *Calcar*. And the *Conciator* never stirs his *Frit* till the smoak is past. The Coals burn (as in other *Furnaces*) on Iron grates, and the ashes fall thence into the athole, 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 onely 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 *Authour* 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

pot into another. And with his *Porteglo* he scums 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 whil' st 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*,



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 stopt 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 *Halpinella'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



three are necessary in all *Crystall Glass-houses*. See variety of them, *Agric. de re Metall.* l. 10. *Libav. Comment. Alchem.* part. 1. l. 1. 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 hear 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 M<sup>rs</sup> are set to anneal; it hath 2. *Boccas* or mouths, one op-

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 Glas 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



*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 an-



neal them in or over the furnace. But those for *Green Glafs* are made of *Non-such clay*, mixed with another clay brought from *Worcestershire*, which bears the fire better than that of *Nonsuch*, 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, neer 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 *rigarines* or other works.

The last business will be to shew the manner of working Glafs, which take from *Agric. de Metall* 1, 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 'tis intended for, the Metall 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 reappplies 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 off 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 *ponteglo* sticks the Glass and scalds it, and with his *passago* makes the bowl of the Glass, then with his *procello* widens and makes it hollower and more capacious, and with the *shears* cuts off what's superfluous, and



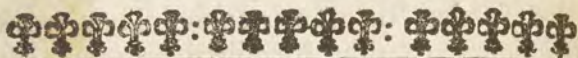
withall making it plain and even. And thus with *blowing, pressing, scalding* (which must be repeated as often as the Glass cools) *amplifying, cutting, &c.* frames it into the shape preconceived in his mind, And when need requires fastens on feet and handles, and with the *Spiei* puts on *Rigazines* 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 falling 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, where:



whereon they hang their instruments, fastened so that 'tis immoveable. They work six hours at a time measured by one Glass onely, 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.

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Observa-



## Observations on the first Book.

**H**AVING 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 sophistication from other salts mixed therewith, or rather from Sea-salt water, or other moisture which much endammageth 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 he 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 Hist. Lugd. Anthyllis, by Camer. Cordus, Fuchs. and Lufitanus, the two latter whereof confidently assert it to be the Anthyllis of Diosc. both which Matthiolus*



thiolus hath fully refuted in his apologie against Lusitanus, who saw this plant grow at Tergestum in Mauritania, and lastly, Antylloides, by Thalius. Soda, Salicornia, and Salsola manifestly derive their name à Sale from Salt, wherewith they all exceedingly abound. Of the Antiquity of knowledge, and names of this plant with us, thus our learned Countrey-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 tast, and Glas-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 tast. Gaspar Bauhin in his Pinax makes ten sorts thereof, whose names and descriptions we omit, as too long for this place. I shall onely mention those three wherewith the Alexandrians, and other Egyptianians make their Polverine for Glass, and Soap, as Alpinus chap. 42. delivers them. The first is Kali geniculatum, the second sort

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 saith 'tis used to make Glass. The third sort more peculiar to Egypt is call'd by the same Author Kali Egyptiacum foliis valde longis hirsutis. And besides these three, I have seen, and have by me a fourth, taken from their Polverine 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 Glas-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  
 Con-



Confectioner whom I know found to his loss, who bought thereof instead of Samphire, For having washed it, and put it to Vineger to pickle, found very little of his Sampire remaining, for the Vineger had well near devoured it all. This great difference of plants in respect of the countrey 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 demizens 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 Countrey 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 dried 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



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. I. **T**O know the quantities and strength of the Salt. *The best and readiest to know this, is that practised by the Soap-boylers, in their Essay-glasses. They dissolve their Soap-ashes in fair water, and Filtre 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 every where 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 Verdigrease. And therefore here they use only Boylers lined on the inside with Lead, such as the Alum and Copperas makers employ to extract their Salts in.*

*Tartar of red wine Calcin'd. Tartar call'd by our Author Greppola and Grumi di 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



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 onely. 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 Polverine, 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 Polverine is put into the boyler. They Calcine their Tartar in an Oven, neer the Leer, in the space of six hours, and that to whiteness too, finding that this hath a better effect, than a meaner calcination hath. What advantage the drawing off the humidity of the Tartar gives, a secret way used by some Chymists doth demonstrate. To make their Crytals and Cream of Tartar, larger, and whiter, they powder it grossly, and then Calcine, or rather dry it throughly in an



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

Chap. 2. **T**Arso. 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 hardness, yet are white and transparent, as that

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 Gliss stone is like in appearance to white Marble, partaking of transparency, 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 its transparency, 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 controversie 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 France stones, and many other which strike fire



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 serced into a most impalpable powder, make incomparable pure, and white Cry-stall 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 the mouths and sides of Rivers; for Crystall 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 100 cubits most worthy of admiration. For there's a valley round in Shew, sending forth



*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 metall 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. l. 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 boild into Glass. That shore is small, but unexhaustible by them that fetch it. The same thing witness Strabo l. 12. Plin. l. 6. Agric. de tofs. 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 metall. Both these cost but little besides their bringing by water.*

Cardan l. 5. de variet. adds Manganese, call'd by him Sydereæ, as a third ingredient in to Glass. Constat (saith he) Vitrum ex tritus, to wit, of stones or sand, of the salt of Cali, and Sydereâ; 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 cut, &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 oyls 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 cappillary herbs have no seed, which they have in great quantity on the back-sides of their leaves, in form of dust, of a  
brown



*brown colour. Nay, Mosses also abound in seed, as 'tis most evident in an undescribed kind of Chamapuce 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. **G**ives an account of other plants, which yield a Salt fit for Glafs. 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 Glafs. 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, and from it's use by Joan, Bauh. lib. 39. c. 2. de Hist. plant. Alga angustifolia vitrarium, 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 Diolc. calls it Algam vulgarem Venetorum, the common Sea-wrack of the Venetians, not onely for the reason before, but also because the Venetians wrapt up their Glasses therein, which they sent to forein parts. This wrack when the Sea is tempestuous, scopulis 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 Ruffia, 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 confus'd one with another, of persons who go up and down the

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 flours 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 fore-mentioned 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, onely 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.



*tent. 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 catel, have been found by experience good to this effect. Add amongst the milky plants, all the sorts of Tithymals or Spürges, 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 unmixt 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. 1. de re rust. c. 40. thus. In oleagineis seminibus videndum, ut sit de tenero ramo ex utraque parte*



parte æquabiliter præcisum, quos alii clavolas alii taleas appellant ac faciunt circumter 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 precedency 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*

tracted from Sea Salt-water, and a little Manganese, 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 shives 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 Unctuousity, 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 sa lib. 31. cap. 10. Quercu crematâ nunquam multum nitrum factitatum est, never much Nitre was made of  
Oak



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, & nigrâ 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 faturare 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 signifie 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 stuble, 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 Sander, being put into the Furnaces.*

Chap. 7. **S**ALT of Lime. 'Tis not here used; that which is sometimes found on old walls, & thence call'd 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 Alum, and of a strong Saline tast. Ferant. 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 plaisterers) 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. **F**RIT, 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 Fritelle or little Frits. 'Twas by some anciently call'd Hammonitrum, and by others more agreeable



greeable to Etymologie Ammonitrum, compounded of  $\alpha\mu\mu\theta$ , sand, and  $\nu\iota\tau\phi\omicron\nu$ , Nitre. For so Pliny, lib. 36. cap. 26. Fine sand from the Vulturian 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 Polverine and sand. The second and Ordinary Frit is made of the bare ashes of Polverine or Birillia without extracting the salt from them, this makes ordinary white or Crystalline metall. Thirdly, Frit for Green-glasses,



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 serced, and then mixed, and equally compounded together, and then the fire of the calcar 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, Zaffer, 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  
T
with

*within few days, if need requires it, though the latter of these two must needs conduce much to the puritie of <sup>the</sup> Glas.*

Chap. 9. **T**He 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 Glas houses, nor in pottery where they have very great use of both. Besides, the metalls 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 streight, 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 bail'd with light and dry wood. Nor why Plurarch 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

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

Casteth forth Sandever, sal Alkali, call'd  
by the French, *Suin de verre*, that is the fat  
of Glass, and by contraction in English San-  
dever. 'Tis a very white salt, and inclining  
neerest to a nitrous tast, 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 com-  
pell'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. whil'st any of it remains in  
the pot, they may not cast in any cold water to  
hinder the boyling over of the metall, for if  
they should, the furnace and pots would be blown  
up

up together. Sandever serveth to make metall's run, and a little thereof put into Antimony and Salt-peter, for making Crocus Metallorum, increaseth 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 Collets, 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 Blisters from it.



Chap. 11. **T** Artar in great lumps, *Be-  
cause 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 it's  
strength. They calcine it in a place made for  
the purpose neer the Leer of the furnace, on ei-  
ther 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. **Z**affer and Manganese, *have  
no other preparation here  
than bare grinding them in the mill to a fine  
powder, and sercing them in the same serces  
wherewith they serce their Polverine, and o-  
ther materials. What Zaffer is I cannot find  
in any Author, few there are that mention it.  
Cardan. l. 5. de subtil. calls it an earth. Est  
alia etiam terra quæ sic vitrum tingit Cæ-  
rulei coloris quam Zapheram quidam ap-  
pellant. There's another earth which colours  
Glass Blew, some call it Zaffer. But since him  
Cæsalpinus, l. 2. c. 55. reckons it among  
stones. Alius est lapis vitrum tingens colore  
coeruleo & si plusculum addatur inficit ni-  
gredine, Zafferam vocant. Hic ex cinereo  
ten-*



tendit ad purpureum ponderosus & friabilis est; per se non funditur, sed cum vitro fluit 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 metall-men in Germanie (from whence all of it comes) and*

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 metalls do give a tincture thereunto. Lapis Lazuli a very hard stone loseth it's colour in the fire, and so do other pretious 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 calcind into good colours for the uses they are employ'd for, yet in the Glass furnaces they wholly lose them. It remains then that nothing but what's mettalline 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 no 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



shall manifestly see some white and transparent gravel, very like the powder of our transparent Pebles, 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



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 perswaded to be of my conceit. 'Tis call'd Zaffer from the Saphyre-stone, with whom it communicates in it's Blew colour.

Chap. 13. **M**Anganese (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 Milefia 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 Cæsalp. l. 2. c. 55. more largely and very well in these words. Hoc genus Magnetis hodiè vulgo Manganesè vocatur,

catur, ab Alberto Magnesia, addi solet ad confectionem vitri, quoniam in se liquorem vitri quoque ut magnes ferrum trahere creditur. Lapis est niger, Magneti similis, quo utuntur vitrearii. Si enim modicum ejus vitro admisceatur, illud purgat 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 continuâ sed sparsâ, 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 liquor 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 else-where. Pliny also mentions the Pseudo-magnes. He saith in Cantabria not the true Load-stone in a*  
*conti-*



continual, but scattered rock, I know not whether it be as good to run-glass, for no body yet hath made tryal of it, it colours (saith he) Iron as the Load-stone doth. Cardan. l. 5. de subtilitat. calls it Sydereia (upon what ground I know not) and mistakes the colour, putting Blew for Red. Whereunto Scal. exerc. 104. 23. replies, Manganese is unknown to me, yet in a Manuscript of blowing Glass belonging to Pantheus a Venetian 'twas written, that Glass 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 carried 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 colour grew white by reason of the strange Cohætion 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-



*nion 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 mettals, 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 metall 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. & Cæalp. mean by their attraction, this purgation, but then they tell us not what becomes of them both. They must be separated from the metall by  
 preci-*

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 cull 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 our selves with those onely which by admixture of colourate bodies become white. Take then Terebinthine which is of a yellowish



lowish colour, or Oleum Capevæ of a blackish colour, or tinge oil of Turpentine with Verdgreas ( 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 produce



duce 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-thrils. And Spirit of Vitriol poured on it boild 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 encreased 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

and doubtless would be of use in the colour pots of the furnace did they know it, and would they use it. Secondly, this Mangantse 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 countrey at Mendip-hills (famous for Lead) in Somerset-shire; as good as any used at Morans where ever 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

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count



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. **F**erretto of Spain, commonly call'd 14, 15. *Æs ustum, or burnt Brass, and 'tis made Latin, by Coesalp. l. 3. c. 5. where he thus saith, Optimum æs ustum conficiebatur in Ægypti Memphide deinde in Cypro, cujus notæ sunt, ut sit rubrum & attritu colorem Cinnabaris imitetur, nam nigrum, plusquam decet exustum est. Hodie in Hispania conficitur, appellant autem Ferretum, sed nigrum est, inficit ingredine, idèd utuntur ad capillum denigrandum. The best burnt Brass was made at Memphis 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 Ferretum, 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*  
of



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 severall 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 Parts, Enamels, Glass of Lead by reason of their great conformity and neerness 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 colour.

lour of Blew the Ground, and Yellow super-in-  
 duced; or contrary-wise wrought. But in other  
 Arts this colour is simple, and both arise from  
 the same materiall Copper or Brass by various  
 ordering and preparing them. 'Tis a strange  
 and great mystery to see how small and undi-  
 scernable a nicety (though the same materialls  
 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 Verdigreus  
 made of Copper-plates buried in the earth  
 with Grapes, makes a Green, but Copperas  
 made with Copper, and the liquour of the  
 Pyrites dissolved with rain water, yields a  
Blew



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 Verdigreus 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 experi-



riment, was once shewed me by my neighbour a Refiner, who bought some Copper-plates to draw down his silver from Aqua-fortis wherein '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, imbibed 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  
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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 juyce, 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 wherewith & 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 plyable 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,

V 4

then .



then with Vitriol, c. 15. Thirdly, a simple calcination of Brasse by fire, c. 20. of scales of Brasse, 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 educed. But above all these preparations, that of Vitriol of Copper carries the pre-eminence, 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 Marcalite, 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 subtilly the smallest particles thereof. Besides the flame dissipateth and carries off the Spirit of the Sulphur, which of it's own nature is apt to blacken, and make all colours more dirty. For



as 'tis well known Copperas with galls 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 intallibly of a dirty Green colour. Wherefore they make their Aqua-fortis of Danzick Copperas onely.

Whosoever then would extract a good colour with Aqua-fortis (which way 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 neerest 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 Sulphurious nature, or convert it to 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 then 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 Verdigreus of each an ounce and fill'd two Glass bottles with the juyce 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 emporeticam, and had from the former a fair Skie, from the latter a pure Sea Green.



*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 juyce 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 menstruums, 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 consequently*



frequently 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 its 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 its denomination thence. 'Tis an excellent dryer, and applyed to Gleetings Nerves, and Tendons, without pain, it soon exiccateth them. This powder I communicated to the eternal glory of our nation, and Anatomy, & an excellent Chirurgical, 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 calcind, 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 equall 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 Calamic is about six or seven foot deep under ground, the earth being circularly raised by degrees from the plain of the work-house 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, wherewith they regulate their fires. At the bottom of this furnace, they have a long pipe or hollow place



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 produceth 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, onely the spots remaining. These stones have formerly been brought from Holland, but have been sometimes since found in the mountanous 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



metall will fly, and besides endanger their breaking. They must have many pair of them in readines, 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 mixt 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 encrease of weight.

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, **D**eliver several ways of 17, 18, 19. **M**aking Crocus Martis, all which and many more are delivered by Chymical Authors. They may be reduced to these



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 brashed 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 terristricty 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.

I shall say no more concerning the tincture of Mars, but that whatsoever of Acid or biting juyces 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



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 onely 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. l. 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

308 Observations on the first Book.  
*made deeper or lighter, for one pound of metall  
one drachm of burnt Brass will suffice.*

Chap. 32. **F**Or 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.

**R**osichiero, whereof thus, *Port lib. 6. cap. 9.* But the more skilful and modern Glas-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. **O**ur Author adviseth you to make your Aqua-tortis, &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 ingredi-

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 distild 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 unrefined 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 sixes, 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. **Y**ou 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 Saltpeter 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 distilld, Aqua-Regis onely blacks silver, but

'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 bath dissolved Gold, then 'twill fall upon Silver or other metalls.

Chap. 42. **T**He ways of making Calcidonies, 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 liquours 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 liquours, that put into the same Glass, would keep their distinct stations and colours, nay though the liquours were agitated and confounded, they would each return to their proper place and stations. In the preparation of these Calcidonies, I shall observe first, that all the colouring



colouring materials, though not all their preparations 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 commends the last before the second, and that before the first. Thirdly, that some ingredients there are in each of them which contribute no colour at all to the metall, such are Tartar, Scot, Sal Armoniac, Mercury. Fourthly, that some of them are of an uneluous nature, 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 sit 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. l. 10. c. 52. de varietate saw a Cart with two Oxen which was covered with the wing of a Fly, Agric. l. 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 Crystall 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 six colours,



*lours, and covered in some places with Gold.*

Chap. 48. **P**Ort. l. 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. l. 4. c. 1. haver corpo dicono quelli colori che coprono e sono senza trasparenza, non havere 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 he, l. 1. 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



with the Blew, and those colours not fading but now continuing for these 12 years past, Libav. de transm. 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, Cerufs 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 uncalcind, which the heat of the furnace reduceth to Lead again, the same was said of Cerufs 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 unctuousity, 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  
by

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 onely 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 it's self into the pores of the pots, and continued there in fusion, will by getting farther and farther by it's 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 Cop-  
 per. 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 ves-  
 sel, 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 tryed. But you must put it  
 into the pot well powdered, wherein you must  
 use not onely Mortars and Mills, but the Por-  
 phyrie-stone, if you would have it lighter,  
 ditute it by adding Glass. Another way reser-  
 ved 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. Hama-  
 titis 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. **B**lew 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 o'ver into the fire, though it rise with the greatest fury.

Chap. 74. **T**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 Crystall, 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 unmixt, 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.

Chap. 75. **T**HE 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. l. 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 no where extant but amongst themselves. They call them Amausa, so Libav. Joan Isaac, but Clauber. Amausæ, which, whether derived from Musaicum (not Mosaicum as Vossius



Vossius in his Glossary, proves at large) I determine not, though this Etymon be very probable, For Molaick work was made in this manner as Hermol. Barbarus, describes it. Musivum opus quod vulgò Museacum vocant, tessularum lapillis variorum colorum, ex quibus arte compositis & coagmentatis omne genus imaginum redditur. Mosaick work they call that which was checquer'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. Plilander in l. 7. c. 1. Vitruvii mentions the reliques of some pavements seen by him, wherein Checquer'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 Syntagn. saith, the Saracenicall Authors call them terra Saracenicca, but he confounds these Enamels and Pastes one with the other. 'Tis true these two are very neer of kin, but are distinguishable by this, that Pastes

are made of Cryftall, prepared and mixed with some Glass, and so wrought into a transparencie, 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 metall 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 Chryfibles be made strong enough to hold them; what he saith in many words, concerning the preparation of Cryftall casting into molds and colours, contains nothing but what's vulgar.

Chap. 76. **H** Artm. in praxi Chym. hath this peculiar way of preparing Cryftall for making of Jewels. Dissolve, saith he, in water two ounces of purified salt of Tartar, which moisten with Beechenashes, 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 Tartar 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 Amethilt, Ruby, &c.

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

Chap. 77. **B**Oeth. de Boodt, an excellent writer upon stones, writes thus of adulterating the Emerald, This may be done several ways. The best is with Crystall, Glafs 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 Balaguat 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



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with Minium four ounces, Cryftall prepared one ounce, gold two drachms; the third with Brals 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 Cryftall 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.

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 Chryfible, and this must be twice done to effect this colour, but this way is wholly insignificant.

Haac 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 Crystalls, as also other pretious stones, and perhaps differs not from the artifice delivered, l. 36. c. 26. de Vitro obsidiano & Myrrhino of many colours.

Chap. 81. **B**apt. 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



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 æs ustum, native Cinnaber and Crytall, 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 Cerufs, and Crytall prepared half an ounce. The Author of quadrig. Chym. makes Salt of Tin to be the Topaz.

Chap. 82. **P**Orta thus imitates the Chrysolite, when you have made a Topas, add a little Brals, 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 Citrin 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



*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 Cerufs, Our Author delivers two ways of making Saccharum Saturni, the one here of Cerufs, 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 obserued 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 vinegar alone, but Beguin he substitutes in it's place Phlegm of distil'd vinegar, but the commentator well passeth a delectur 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

on

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  
from



from the Duch word Emailleren or the French Emailler which comes à maille macula a spot as Minsheu, for so 'tis laid on. In Latin Encauston (that is burnt in, a  $\nu\alpha\upsilon\omega$  to burn) for so the Lexicographers render Eucauston Enamel, Encaustice, the art of Enamelling, Encaustes an Enameller. But the Encaustum of the Ancients whereof Vitruv. l. 7. c. 9. Plin. l. 35. c. xi. Mart. l. 1. &c. make mention, was a thing quite different from our Enamelling. Concerning which, and the three kinds thereof, see at large Salmaf. 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. **W**Hite 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. **F**Or a Green Porta takes æsustum which the common people (saith he) call raminella, and by our Author ramin<sup>1</sup>, 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. **B**Lack 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 flours of all sorts in their proper and genuine colour. The vertue of pot ashes (which the dyers



*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 onely 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. **W**Hatsoever herb, or flower. *The tryal of our Author is good, but stayning of linnen is a better sign. The rule given by the Merchant to the Mariners in their instructions for forein 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. Campesiana 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 Cochineal, yet they are used in stead thereof. Red-wood, Symach, Brafiletto,*

filetto, or Sweet-wood, Turmerick, 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, Phalangium 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 leaved 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 Wort, and Tutfan have a reddish juyce in their tops. Celandine the greater, and Felfel Alpini give a Yellowish juyce. The Berries of many plants,*



plants, also affords colours, as D wale garden, Night-shade, the Bryonies, Ruscus, Solomons Seal, Herb Christopher, Rasberries, Great-bearing-Cherries, Spina Cervina, the Painters Sap-green, Wall-nuts, Bezetta, Seu Torna solis Bezedini of Wormius in his Musæum, l. 2. c. 34. who thus describes it. 'Tis a fine linnen cloath impregnated with a most Red and Elegant Tincture, But how 'tis prepared, and what is the way of making it, the doner of it Christopher Herfurt the Apothecary of King Christian the fifth knew not. It seems to be the tincture of Red-sanders, 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 it's 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, balautia 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,

*Succory flowers, the flowers of the Scarlet Bean, of the Indian Scabious, the Golden Marigold of Crete, Cerinthe and Indian water Cresses, and many other whereof (God-willing) at large hereafter, especially since no Herbarist hath taken notice of the tincture of Plants, nor put them in any tribe, which are of very great use in many Trades, and some of those before-mentioned, have been brought into use by Trades-men; Leaves that colour, are stramonium Arbor tinctoria of Virginie whose leaves rub'd on the hands, gives the deepest Green I have seen from any Vegetable, Leaves of Acanthus or Bears-breech. The true Tobacco-leaves, the flowers of Nigella Hispanica, which though Blew, being rub'd on the hand, paper or linnen, give a fair Green-colour.*

*This way of extracting colours by distillation is now well known and practised, for all the Spirits Chymically drawn, rise white, and they are coloured either by infusion of materials that have tinctures in them, as in the Pharmac. Lond. the compound Spirit of Lavender, and compound Poppy-water, and Aq. Mariæ, &c. and most Pharmacopœas, and Chymists teach this way of our Author.*

*But*



*But the extraction of the Spirit of the wine thus tintured will render the colour dead, and worthless, unless you draw but a little of it, and with no stronger a heat, than that of B. M. for too much heat turns all the colours of Vegetables Black, Nay, Lapis Lazuli a hard stone, by too great a heat loseth it's colour.*

Chap. III. **T**His preparation I made, and had a dirty Blew therefrom which would do no feat in Pottery. Our Author calls this Blew of Germany, and so doth Birelli, l. XI. c. 106. onely Birelli useth Brimstone, and takes but four parts of Sal Armoniac, you may see many other of this nature there.

Chap. III. **T**O restore the decai'd colour of Turcoises. I doubt and have been told this will not succeed, yet may be much better than those of Isab. Cortes, l. 3. c. 53. She rubs the stones with Ultramarine that hath stood a day in Aqua-fortis, which being evaporated and dryed, the powder may be used. Secondly, She infuseth them in Aqua-fortis, made of Vitriol and Brass, then in Vineger, and last of all in water, and each of them some time.

Chap. 113. **A** Mixture to make Sphears,  
*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 Sphears or Glasses  
 are call'd Metalline, not because they are made  
 of metall, but because some Metalline body's are  
 mixed with them, and they do as to weight, and  
 appearance much resemble them. Porta. Mag.  
 l. 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 there-  
 in of Tartar and CrySTALLINE Arsnick of each  
 two pound, when you see them smook, put in  
 fifty pound of old worn-brass, melt them six or  
 seven times, that they may be purified and re-  
 fined, then presently add twenty five pound of  
 English Tin, and melt them all together.  
 Take a little hereof 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 de-  
 sired 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 <sup>2</sup>Emerie,  
 when*



when you see the superficies smooth and polished, rub it with Tripoly, and lastly with fine 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, lest the motion of the wheel should break the Glass plain a piece of wood, and make it of the shape

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*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 18<sup>th</sup> part of Antimony. Most leave out the silver for the charge, others add onely a 24<sup>th</sup> 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 Orpiment, all boild so long as they smoak. Then they fashion the Molten Metall into the figure of a Looking-Glass, on plain tables, heated and dryed 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 metalls, 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 dried 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.*

*Cornaxus 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*

(from which keep your mouth and nose) vanish, then cast it into a mold. I have found (saith he) 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, l. 9. c. 47. to the 55. to whom for brevities sake I refer you.

Chap. 114. **T**His 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, commonly hung up in houses.

Gesso. whereof thus Casalp. l. 1. c. 9. (the onely Latin Author I find mention it) est alia terra pallida glebis lapidosis qua utuntur ad Aurichalcum tergendum, vulgo vocant gessum. There's another pale earth with stony clots, which they use to scoure Brass, 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 stony substance, glittering with spots, as Spar doth in Lead and Tin Ore, and pretty ponderous. To the eye it much resembles Alabafter, and is brittle as it,  
for



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. **U**Ltramarine, so call'd as Cæsalp. 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. calls 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 Cherries 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)*



be) 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 receipts for making Lakes, differing onely, either in the materials from which, or in respect of the Menstruum wherewith they are extracted. Some use Cherries-berries 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, neer the Pest-house, but it never bore fruit in England, another grew in his Majesties Privy-garden at VWhite-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 Scowrings of Cloath dyed in Stammel or Scarlet.

Hernandez in his Hist. l. 3. chap. 45. thus of making Lake in the Indies. Of Nocheztlī, 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 decoction 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 VVillow, or of other soft VVood. 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 onely. 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



*the colour, precipitating streyning and 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 Verditer 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. **B**irelli 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 streins it, and adds to the streyned liquor one ounce of Gum Arabick in powder, and reboils it, and boils away half as much as before, then mixeth both the liquours 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 Cinnaber 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.



Chap. 126. **T**O fix Sulphur he teacheth another way, Chap. 129. Another Process to the same purpose, but much larger, Birel delivers, l. 1. 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 no where mentions any use of this powder in the Art of Glass.

Chap. 129. **A** Transparent Red. Libav. l. 2. Tract. 1. 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.

Chap. 131. **T**O make vitriolum Veneris, Glaub. l. 2. Furn. Philosop. proposeth this short way. Spirit of Sal Armoniac powred 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. Begun, c. 17. sets down this way, Powder calcin'd Copper, or it's scales very fine, which digest 24 hours in distil'd vinegar. Pour out the Tinctured Vineger by inclination, and pour on more till 'twill be no more coloured. Filtre the decanted liquours, Evaporate, or distil off a third part, set the remainder in a cold place, and you shall have Green and obscure Vitriolum Veneris.

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FINIS.





AN  
ACCOUNT  
OF THE  
GLASS DROPS.



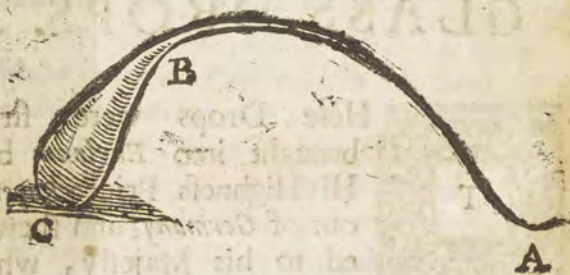
These Drops were first brought into *England* by His Highness Prince *Rupert* out of *Germany*, and shewed to his Majesty, who communicated them to His

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 new and more exact experi-

experiments to be made in any kinde  
whatsoever, as being done with exceed-  
ing exactness.

*This account was given to the  
Society by Sir Robert Mo-  
ray. MDCLXI.*



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

They are made of *Green-glass* well re-  
fined; till the Metall (as they call it) be  
well refined, they do 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 whilest they are in the water, and fly to pieces of themselves with a smart noise as

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 thread 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.



The outside of the Glass drop is close and smooth like other Glass, but within it is spongius, 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 proturberance 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

bubble in oyl longer than in water.

Those that are made in oyl 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 oyl, & that part of the small thread that is quenched in it cool'd, breaks like common Glass. But if the neck be broken neer 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 vineger, 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 pieces.

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 vinegar.

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 used.

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 onely one succeeded, the

rest all cracking and breaking into pieces, onely some of the company, who taking the Glass in their hand, as soon 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 off 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



Some being rubed upon a dry tyle, fly into pieces by that time the bottom is a little flatted, 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

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 peirce 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.

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F I N I S.



## 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.

**T**WO Bars to lift their pots into the Furnaces, each neer 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 Sandever, 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 Ser-  
vitors 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 fa-  
shion the Glass.

Scissors cut the Glass, and even it.

Cranny



An Appendix.

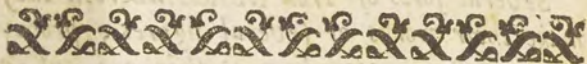
*Cranny is a round Iron whereon they roul  
the Glass to make the neck of it small.*

*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, protu-  
berances, &c. according as they are cut in  
them.*

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FINIS.



Errata Corrigenda.

**E** Pist. Ded. read pour on you, p. 12. line. 2.  
r. from although to the end at the latter end  
of Chapt. 3. p. 16. l. 13. &c. r. refine the Glass, *ib.*  
l. 16. r. is made. p. 24. l. 14. r. 10. p. 106. l. 15. r. lead  
again. p. 159. l. 11. for Cochin r. Blew. p. 205. l. 8. r.  
Borint. p. 208. l. 16. r. I sod. p. 209. l. 13. r. Belluac.  
p. 267. l. 17. r. that make. p. 320. l. 4. r. cast the  
water on.

