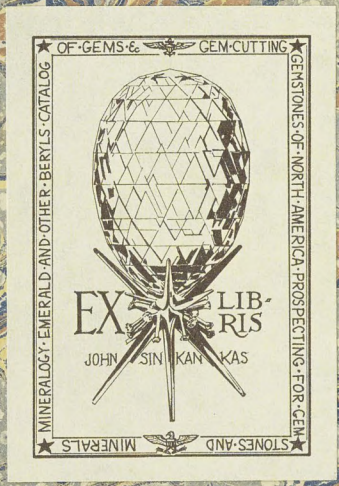
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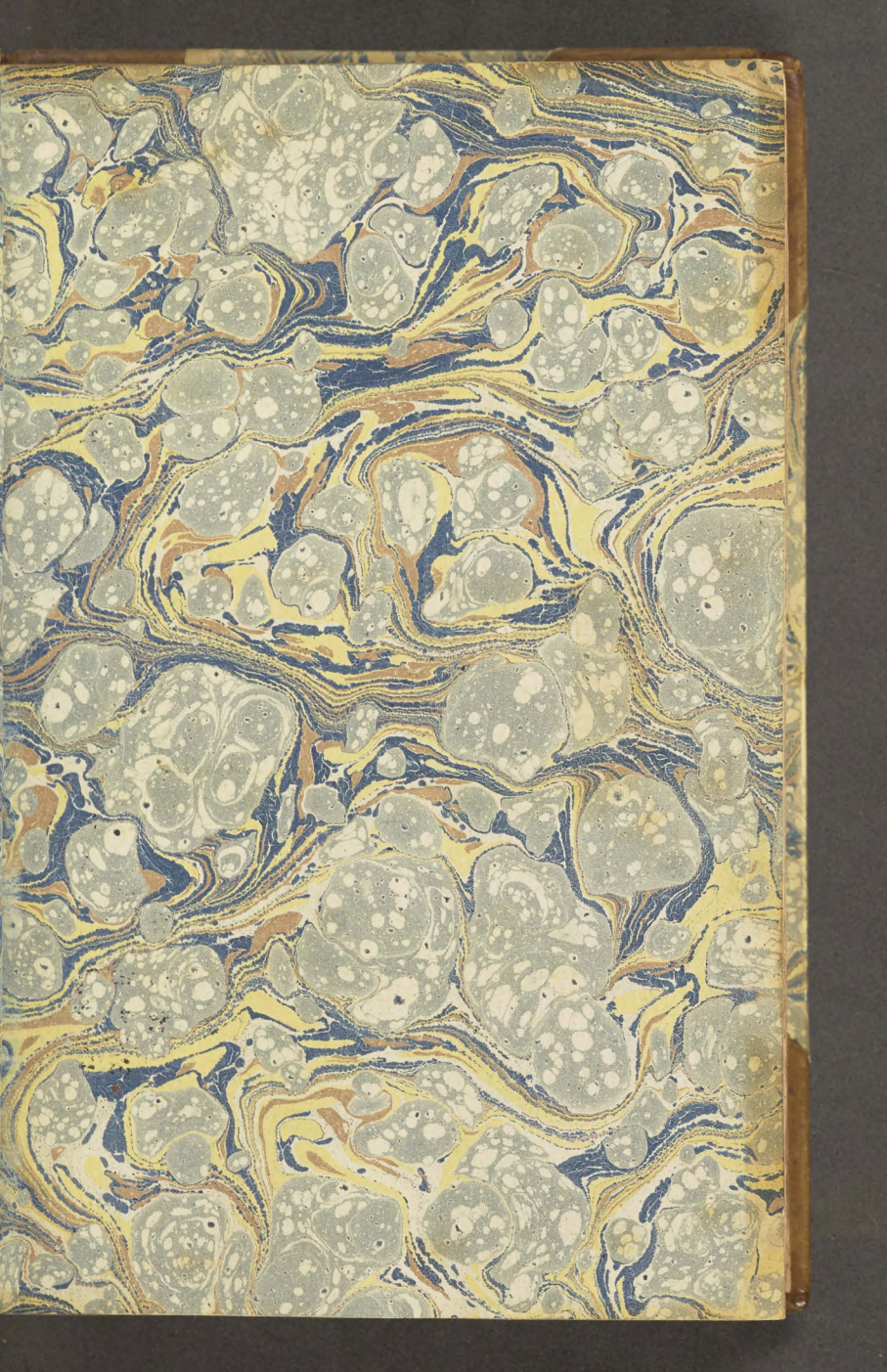


1st English Edition

Ferguson, II, p. 134-5

11/80 1680vo
Marlborough

Imprimatur,

Ex Æd. Sab.
10. Sept.
1662.

G. Stradling Rever. in Christo
Pat. Gilb. Epiſc. Lond.
Sacell. Domeſt.

THE
Art of Glaſs,
WHEREIN
Are ſhown the wayes to make and colour Glaſs, Paſtes, Enamels, Lakes, and other Curioſities.

Written in *Italian* by *Antonio Neri*, and Tranſlated into *Engliſh*, with ſome Obſervations on the Author.

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

LONDON,
Printed by *A. W.* for *Octavian Pulleyn*, at the Sign of the *Roſe* in S^t. *Pauls* Church-yard. *MDCLXII*.

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

Antonio Neri.

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

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

of

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.

To the Curious Reader.

THere 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 midle 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 Spagyrical, *not to ſay neceſſary to prepare Medicines for man, which would be im-*

possible to be made without the means of Glass, so that herewith are made so many sorts of Instruments, and Vessels, as Bodies, Heads, Receivers, Pelicans, Lutes, Retorts, Athenors, Serpentines, 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 Maslers 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 abounding 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

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

Sea, 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 wholy 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

of

of leſs charge, and more beautiful and of greater efficiency: eſpecially in Sphears, 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

matter that I treat of in this present work, the diligent and curious operator shall find, that I have wrote and shown truth, not told me, or perswaded me by any person whatsoever, but wrought and experimented many times with my own hands, I having always had this aim to write and speak the truth. And if any one trying my receits, and manner of making colours, Paste, and Tinctures, doth not speed to do so much as I write thereof, let him not be amazed thereat, nor believe that I have writ untruths, but let him think that he hath erred in 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 Foyls, as in Rings, or other where, must always be clear, and

of

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 Glass 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

be incouraged perhaps to publish my other labors wrought for many years in divers parts of the world in the Chymical and Spagyrical Arts, than which I think there is no greater thing in nature for mans service, known and perfect in ancient times; which made men 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

To the Honourable,

And true Promoter

of all solid Learning,

Robert Boyle, *Esq*;

SIR,

THis Treatise challengeth the inscription 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 knowledge, but have also taught it the true use of that most beneficial Art, as to the improvement of Reason and Philosophie. Most Writers therein delivering onely a farrago of processes and unintelligible Enigm'as. But You have chalked out the way of solid reasoning upon whatsoever occurrs to observation in such experiments. Next, you were the principal cause

that

that this Book is made publick, by proposing and urging my undertaking of it, till it came to a command from that most Noble Society, and serious indagators of Nature, meeting at Gresham College, *whose desire I neither could nor ought to decline. Though their, and your choice might have been much more happy, there being many of that company far more adapted for this undertaking than my self. Besides, I doubt not but You will much promote by Your practice the Art it's self, there being scarcely any thing contained in it, but You have already judiciously had experience in. Not, because this Translation will any whit avail You (since Your skill in the native Language is sufficiently known to all that have the honour to be acquainted with You) but may be 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 errours, 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 thorowout 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

of Lead? Though you may find some needless repetitions too, in this Translation not omitted. I confess these reiterations caus'd a nausea in my self, and believe they would in thee, and therefore I passed them over. Then observe that there being many words peculiar to this Art, I was compell'd to have recourse to the workmen, and for such things, and materials not used nor known here, to take them upon trust from such workmen as have wrought at Muran *and other parts of* Italy. *As for other things I have carefully 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*

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

Fruere & utere.

C. Merret

To

To avoid our Authors Repetitions, Observe

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

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

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

4. Manganese *consumes the natural greenness of Glass.*

5. *Copper, Brass, Lead, Iron, and all compositions of them as also* Manganese, *must be put into the metall, but a little at a time, and at convenient distances, and the pot must be large, and not filled too full, because they all swell and rise much, and so are apt to run over into the fire to your loss.*

To extract the salt of Polverine, Rochetta, *and* Barillia, *wherewith Crystall Fritt called* Bollito *is made.*

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

CHAP. I.

Polverine, or *Rochetta*, which comes from the *Levant* and *Syria*, is the ashes of a certain herb growing there in abundance: there is no doubt but that it makes a far whiter salt than *Barillia* of *Spain*, and therefore when you

would 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

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 Crystall. 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 ten 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 ſetling 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 dryed, beat it grosly, and put it into the Calcar to dry, with a most gentle heat, and with an iron rake it must be broken, and mixed as the Fritt is; when it is well dryed from all its moisture, observing alwaies that the Calcar be not very hot, but temperate, take it out of the Calcar, and pound it well, and sift it so, that the greatest pieces which pass thorow, exceed not the bigness of a grain of wheat.

This salt thus pounded, sifted and dryed, must be kept by it self, in a place free from dust, for to make Fritt of Crystall: the way to make this Fritt is this which follows.

The

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

CHAP. II.

WHen you would make fair, and fully perfect Crystal, see you have the whitest *Tarso*, which hath not black veins, not yellowish like rust in it. At *Moran* they use the pebles from *Tesino*, a stone abounding in that River. *Tarso* then is a kind of hard, and most white marble, found in *Tuscany*, at the foot of the *Verucola* of *Pisa*, at *Seraveza*, and at the *Massa* of *Carara*, and in the River *Arnus*, above and below *Florence*, and it is also well known in other places. Note, that those stones which strike fire with a steel, are fit to vitrifie, and to make glass and Crystall, and those which strike not fire with a steel, will never vitrifie, which serves for advice to know the stones that may be transmuted, from those that will not be transmuted into glass.

Take then of the best *Tarso*, pounded small,

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

The Calcar is a kind of calcining furnace, the rake is a very long inſtrument of iron, wherewith the Fritt is continually ſtirred; both theſe are very well known, and uſed in all glaſs furnaces. At the end of 5 hours, take the Fritt out of the Calcar, which in that time (having had ſufficient fire, and being well ſtirred) is made and perfected. Then put this Fritt in a dry place on a floor, and cover it well with a cloath, that no duſt nor filth may fall upon it: for herein muſt be uſed great diligence, if you will have good Cryſtall. The Fritt

thus

thus made, becomes as white as snow from Heaven. When the *Tarso* is lean, you must add somewhat more than ten pound of the salt to the quantity aforesaid. Wherefore let the experienced Conciators alwaies make tryal of the first Fritt, by putting it into a chrysible, which being put into the furnace, if it grow clear, and suddenly, they know whether the Fritt be well prepared, and whether it be soft, or hard, and whether the quantity of salt is to be increased, or diminished. This Crystall Fritt must be kept in a dry place, where no moisture is, for from moist places, the Fritt suffers much, the salt will grow moist, and run to water, and the *Tarso* will remain alone, which of 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 Crystall 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.*

CHAP. III.

TAke *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 glased, 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 glaſs bodies, luted at the bottom, in furnaces, in aſhes, or ſand, at a gentle fire, and at laſt when the ſtuff is dryed, obſerve that ye fire be very gentle, that the ſalt be not burned nor waſted. When the ſalt is dried, take out the glaſs bodies and ſee if they be broke at the bottom, which is wont to happen often, in which caſe put the ſaid ſalt into other good glaſſes, well luted at the bottom, and fill them at the top with common pure and clean water, which ſet in the furnace, in aſhes or ſand, at a gentle fire, and always evaporate an eighth part of the ſaid water, then, the furnace being cold, empty this water fully impregnated with ſalt into earthen pans glaſed, and when the water is ſetled 24 hours, filtre it with diligence, that the ſalt may be ſeparated from the reſt of the terreſtriety and dregs, let this lee be evaporated in glaſs bodies with a gentle fire, and at laſt more gentle, that the ſalt be

be not burned, put this salt again into glass bodies to be dissolved in common water, in every thing as before repeat this work, till the salt yields no more terrestriety, or dregs, then shall you have a pure and perfect salt wherewith a Fritt made with *Tarso* as before, will make a Crystall, which in fairness, whiteness, and cleerness, will excel natural Crystall.

An observation for Gold Yellow, in Crystall.

CHAP. IV.

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

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 succes and my great content.

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

CHAP. V.

IN *Pisa* I made experience of Fern-ashes which groweth in great abundance in *Tuscany*, which herb must be cut from the earth, when it is green, from the end of *May* to the midst of *June*, and in the Moons increasing, when it is near it's opposition with the Sun; for then the 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 wither-

thereth; then let it be well burned to ashes, with these ashes, and with the rules, observations, and diligence given before for the salt of the *Polverine* of the *Levant*, is extracted a pure and good salt, wherewith I have made Fritt with good and well ferced *Tarso*, the which Fritt melts well in the pot, and yieldeth a fair Crystall, and much better than the ordinary Crystall, because it had more strength and bended much better, which the ordinary Crystall doth not, it is drawn into fine 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 Crystal is much fairer and pleasanter than can be wrought with the Crystall made with the salt of the *Levant Polverine*, and with that Crystall cannot be made all sort of works as with the other.

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

CHAP. VI.

LEt there be made ashes after the manner aforesaid, of the Cods and Stalks of Beans, dried in the summer, when ye husbandmen have thrashed and separated the Beans, with which ashes, with the rules and pains 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 fen Reeds, and many other herbs which yield a salt, wherewith (making Frits after ye accuſtomed manner) will be made moſt beautiful Cryſtall, as every noble and curious ſpirit may try by experience, for thereby more is learned than by long ſtudy.

A ſalt that will make a very fair Cryſtall.

CHAP. VII.

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

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

CHAP. VIII.

FRitt is nothing else but a calcination of those materials which make glass, and although they may be melted, and make glass without calcination, yet this would succeed with length of time and wearinesse, 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 goodnes 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 Crystall; *Barillia* of *Spain*, though it be usually fatter than the former, yet it makes not a glass so white and fair as that of the *Levant*, because it always inclines a little to an azure colour.

To make then Fritt, 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 said lee, yet it doth well, and maketh it easier for melting. Wherefore Fritt should stand, when made, some moneths; which thus made alway causeth less wood to be consumed, and the glass clear and sweeter to work.

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

CHAP. IX.

TAke Cryſtall Fritt diligently made, ſet it in pots in the furnace, where there are no pots with colours, for the fumes of metalls 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 metalls 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 Crystall, and maketh it obscure and cloudy, and whilst it is a working still casteth forth *Sandever*, a thing very foul. Then put it again into a clean pot, and cast it into water, which is to be repeated as often as is needful, until the Crystal be separated from all this salt, but this is to be left to the practice of the Conciator, then set it to boil 4 or 6 days, and let as little Iron be mixed therewith as is possible, for it gives it always a blackish tincture. When it is boiled and clear, see whether it hath enough *Manganese*, and if it be greenish, give it *Manganese* with discretion. Wherefore to make good Crystall put in the *Manganese* by little and little at a time, for it makes the Crystall of a murry colour, which afterward inclines to black, taking from it it's splendor; mix the *Manganese*, and let the glass clarifie till it becomes of a clear and shining colour. The property of *Manganese* is, being put in just quantity to take away the foul greasines which Crystall always hath, and to make a resplen-

resplendent white, when the Crystall is clear limpid & fair, work it continually into vessels and works that most please you, but not with so great a fire as common glass is wrought with. Be careful that the Irons wherewith you work be clean, and that you put not the necks of the glasses where the Irons touch (for there always remaineth Iron) into the pots of Crystall, for they make it become black. But this glass where the Iron rods touch may be put in to make glass for vulgar works.

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

CHAP. X.

FRitt of *Polverine* makes a white and fair common 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.

To make Purified salt of Tartar, *for the work above said.*

CHAP. XI.

TAke *Tartar* of red wine in great lumps, and not in powder, Calcine it in earthen pots between live coles till it become black, and all it's unctuosity be burned away, and till it begins to grow white, but let it not become white, for then the salt will not be good. Put the said *Tartar* thus Calcined into great earthen pans full of common water heated, as also into earthen pots glased, & make it boil with a gentle soft fire in such sort that a quarter of the water may be exhaled in two hours, then take them from the fire, and suffer the water to cool, and become clear, which decant off, and it will be a strong lee, then put in more common water into the said pans after the same manner, and upon the remainder of the *Tartar*, and let them boil as before, repeat this until the water become no more saltish

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 setling, 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* serced with a dose of *Tarso* or sand will make a Fritt, which in the pot will yield Crystalline and common glass much fairer than that that is made without the addition of this salt of *Tartar*, and although a fair Crystalline may be made without it, yet notwithstanding a much fairer may be made with it.

To prepare Zaffer *which serves for many colours.*

CHAP. XII.

TAke *Zaffer* in gross pieces, put it into earthen pans, let it stand half a day in the furnace, & then put it into an Iron ladle to be heated red hot in the furnace, take it thence thus hot and sprinkle it with strong vineger, as soon as 'tis cold grind it fine on a Porphyrie stone, wash it in earthen pans 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.*

CHAP. XIII.

TAke *Manganese* of *Piemont*, for this is the best of all the *Manganeses* 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.*

CHAP. 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 Calcined, and it will be broke in pieces by the fingers as if it were dry earth, and will be raised into a black and reddish colour. This Copper being beaten small and serced in a fine serce is kept well closed for use.

Another way to make Ferretto *of* Spain.

CHAP. XV.

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

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

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

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

CHAP. XVI.

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

Take filings of Iron (if you can have them, those of steel are better) mix them well with three parts of powdered brimstone, and keep them in a melting pot in a furnace to Calcine, and burn well off all the

the brimstone, which soon succeeds, let them stand four hours in burning coals, then take and powder, and serce them thorow a fine serce, and put them into a Chrysible covered and luted at the top, & set them in the Leer of the furnace neer the occhio or the cavalet 15 days or more which then gains a reddisʃ Peacock-like colour, as if it were purple, this is kept in a close vessel, for the use of glass colours, for it worketh many fair feats.

The second way to make Crocus Martis.

CHAP. XVII.

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

Take filings of iron (steel is better) mix them well in earthen pans with strong vineger, onely sprinkling them so much

that

that they may be wet 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 glass.

A third way to make Crocus Martis.

CHAP. XVIII.

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

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

A fourth way to make Crocus Martis.

CHAP. XIX.

THis is the fourth and last way to make *Crocus Martis*, and perhaps the best of all, though each of the ways shown by me, are not 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

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

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

CHAP. XX.

BRass (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 Chrysible covered and luted at the top in coals on a strong fire. I put it in the burning coals of the furnace where they are stirred, there let it then stand four days in a great, but not in a melting fire, for if it be melted, all the labour is lost, in that time it will be well Calcined, powder it into a most subtil powder, and 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 glass it makes it swell, and when it makes not the glass arise and boil well, it is a sign, either that it is not well Calcined, or that it is too much burnt, in which two cases, it makes not the glass boil, neither doth it colour well.

To

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

CHAP. XXI.

TAke Brass and cut it small with sheers, and put it in a melting pot, make a S S S. with powdered Brimstone, and set it on kindled coals, put it in the burning coals of the furnace to Calcine for 24 hours, then powder, 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.

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

CHAP. XXII.

SEa-green is one of the principal colours given to glass, and if you would have it fair, and to hold at all trials, you must always make it in glass called Artificial Crystal; for in ordinary metall it ariseth not fair: and though in Crystalline it ariseth fairer than in common glass, yet in the said Crystal, 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 oyly 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 thorow 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.

Skie Colour or Sea-green.

CHAP. XXIII.

SEt in the furnace a pot of pure metall of Fritt from *Rochetta*, or *Barillia* of *Spain*. The *Rochetta* of the *Levant* does best. As soon as the metall is well purified, then take to a pot of 20 pound six ounces of Brass calcin'd of it's self, as in 20 *Chap.* put it into the metall as is said in the Skie-colour in every particular; observing that this metall be skummed very diligently with

with a ladle. At the end of two hours the metall must be very well remixed; take thereof a proof, and leave it so 24 hours, then it is mixed, and wrought, and this will be a most fair and marvellous Skie-colour varied with other colours, which are made in the art of glass. This colour tinged many pots in *Pisa* in the year 1602 and there came out a fair colour bearing all proofs.

A Red colour from Brass for many colours.

CHAP. XXIV.

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

Brass

Brass thrice Calcined to colour glass.

CHAP. XXV.

PUt the said Brass into the *Fornello*, or on the Lere of the furnace neer to the occhio, into earthen tiles or pans baked, Calcine it four days together, and it will become a black powder, and stick together, powder it again, ferce 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.

CHAP. XXVI.

TO a pot of Crystal Fritt containing 40 pound not charged with any *Manganese*, but well scummed, For when you would make a Sea-green, never cast the Crystal into water, but onely scum it carefully, when this Fritt is melted and well purified, take 12 ounces of thrice Calcin'd brass, and therewith mix half an ounce of *Zaffer* prepared, unite these two powders well together, and put this mixture into the pot at four times, for so the glass receiveth it better. Mix the glass and powder with diligence, let them stand two hours, then remix them & take a proof, & if the colour be full enough, let them stand; And although the Sea-green appears too full, yet the salt which is in the glass will eat up and consume the said greeness, and will always incline it to a 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 erring. 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.

General obſervations for all colours.

CHAP. XXVII.

THat the colours may ariſe in full beauty and perfection, obſerve that every pot great or ſmall, that is new, and put the firſt time into the furnace, leaves a foulneſs in glaſs from it's terreſtriety, ſo that all the colours that are made in them appear bad and foul; wherefore thoſe pots that are very great may be glaſed with white melted glaſs, as the Conciators well know, but the ſecond time the pots loſe this foulneſs. Obſerve ſecondly, that thoſe pots which ſerve for one colour muſt not be uſed for another, for example, a pot which hath been uſed for yellow, is not good to make a grain colour, and that which makes a grain

grain-colour is not good to make a green-colour, and that which serves for a red is nor good to make a blew, and so of all other colours. Therefore every colour must have it's own pot, for in this manner the colours will become more perfect. Thirdly, that the powders be well Calcin'd (that is) neither too much, nor too little; for in either of these cases they do not colour well. Fourthly, that a due proportion, and dose be used, and the mixture be made in proportion, and the furnaces be hot, and fed with dry and hard wood. Fiftly, that the colour must be used dividedly, to wit, one part in the Fritt, and the other in the metall, when it is melted and purified. There are other observations also which shall be treated of in their places, when we treat particularly of colours.

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

CHAP. XXVIII.

TAke the Scales which the Brasiers make when they hammer pans, kettles, or other works of brass, which being often put into the fire the workmen hammer them, and these scales fall off, which cost much less than solid brass, wherewith is made the stuff hereafter described. And to Calcine it, you need not open and shut again the arches of the furnace (as in the aforementioned way) a thing of much disadvantage and disturbance to the furnace. Take then those scales that are clean, and free from all earth and foulness, wash them with warm water many times from their filth and uncleaness, 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 Crystal metall, with the above-said scales.

CHAP. XXIX.

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

of both ways, and ſtick to the beſt. Then take of metall well purified the ſaid 60 pound, and one pound and a half of the ſaid ſcales made with leſs charges, four ounces of *Zaffer* prepared, mix well theſe two powders together, put them to the Cryſtall at four times, mixing well the powder with the metall for two hours, than put it again to be well remixed as 'tis uſual, and take a proof. Herewith I have made many times a moſt fair Sea-green with happy ſucceſs. Mix half Cryſtall with *Rochetta*, and you ſhall have a Sea-green every way beautiful.

A Sea-green of leſſer charge.

CHAP. XXX.

TAke the ſame Braſs prepared (as before) with the ſame quantity of *Zaffer*, put them in the ſame manner and form to the *Rochetta* of the *Levant*, and alſo to that of *Spain*, neither of which hath had any *Manganeſe*, and which hath been well skummed, and not paſſed thorow water, uſing

fing the rules as aboveſaid in Cryſtal; 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.

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 porportion (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

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.

A green Emerald colour in glass.

CHAP. XXXII.

IN making Green you must observe that the metall have not much salt, with metall that hath much salt as Crystall and *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^ch^ will make the glass come out Yellowish, and takes away the foulness and Blewness, which the metall always hath. This process will give the metall a fair Green. Put of thrice 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.

A Green fairer than the former.

CHAP. XXXIII.

But if you would have a Green much fairer and shining than the former, put into a pot of Crystalline which hath not had any *Manganese*, and which hath passed thorow water once or twice, till all the 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.

CHAP. XXXIV.

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

Another

Another Green, which carries the Palm *from all other Greens, made by me.*

CHAP. XXXV.

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

A Blew or Turcois, *a principal colour in this art.*

CHAP. XXXVI.

Put sea salt which is called black or gross salt (for the ordinary white salt which is made at *Volterra* is not good) into the Calcar or Fornello till all the moisture be evaporated, and it becomes white, then pound it well, to a small white powder. This salt so calcin'd, keep to make a Blew or *Turcois* colour. Put into a small or great pot of Crystal metall died with the colour of Sea-green (made, as hath been said many ways.) But let the colour be fair and full (for this is of great importance to make a fair Skie colour) according as you would have the Sea-green fair and excellent. To this metall so coloured, put of the said salt calcin'd into the pots, mixing it well with the metall, and this is to be put in by little and little until the Sea-green lose 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 crakcles 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 prised 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.

The

The second Book, wherein are shown the true ways of making Calcidony *of the colour of* Agats, *&* *oriental* Jaspers, *with the way to prepare all colours for this purpose, and also to make* Aqua-fortis, *and* Aqua Regis *necessary in this business.*

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

CHAP. XXXVII.

SInce I am to shew the manner how to make *Calcidonies*, *Jaspers* and Oriental *Agats*, it is necessary first to teach the prepa-

preparation of some mineral things, for such compositions, and although some of them may be publiquely bought, yet notwithstanding, I being desirous that the work should be perfect judged it pertinent to my purpose to shew the most exquisite Chymical way, that the skilful may make every thing of themselves, both more perfect and with lesser charge. For there is no doubt that when the materials are well prepared, and the colour of the metalls is well opened, and separated from their impurity and terrestriety which usually hinder the ingress of their tincture into glass, and their union in their smallest parts, that then they colour the 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 toyes 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 *Jasper* 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 glass, 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 ariseth in this particular, where I demonstrate every particular so distinctly, that any practitioner, and skilful person, may understand and work without errour, and he that works well may find out more than I set down.

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

CHAP. XXXVIII.

TAke of Salt-peter refined one part, of Roch-alum three parts; but first exhale in pans all the humidity from it;

it ; to every pound of this ſtuff add an ounce of Cryſtalline Arſnick (this is a ſecret and no ordinary thing) which beſides it's giving more ſtrength to the water, helps to extract, better the ſpirits from the materials , which are the true nerves and ſtrength of the *Aqua-fortis*, without which the water perhaps would be no better than well-water. Powder and mix them well together, adding thereunto the tenth part in the whole of Lime, well 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^ch^ incorporate well with the lute, 'tis a buſineſs of importance,

tance, then lute the glasses with this perfect lute, and set them in wind furnaces, fitting to their bottoms, baked earth which will bear the fire. Under the bottom of these bodies, let there be four fingers of sand, & thick Iron bars to bear the weight, & fill'd round about with sand, put receivers of glass to them, large and capacious within, lute the joynts well with lute made of fine 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 dryed and rould about three or four times, make a very strong lute, rouling but once at a time, and letting it dry a little before the second rouling. And then this will bear all the violence, fury, and force of the spirits of the *Aqua-fortis*, and to this end fit exactly a very large receiver to every glass body. And when they are well dryed make a fire in the furnace onely with coal at first, and that a very temperate one, for three hours, for in that time the windy moisture distilleth off, which endangers the breaking of the glasses, and continue for six hours a moderate fire, afterwards

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 tinged with Yellow, a ſign that the ſpirits begin to riſe; continue this degree of fire untill the ſpirits beginning to condenſate colour Red the receiver and head, which will always grow deeper colour'd like a Rubie. Then encreaſe the fire for many hours, till the head and receiver become Red, which ſometimes laſteth two whole days. Continue the fire by all means till all the ſpirits of *Aqua-fortis* be diſtill'd off, wch is known, when the head & receivers by little and little, begin to grow clear, and become white as at firſt, and wholly cold; yet notwithſtanding continue the fire one hour more. Then let the furnace cool of it's ſelf. Obſerve, that when the head and receivers are Red, and the fire ſtrong, you admit no wind, nor cold air into them, nor touch them with any cold thing, for then they will eaſily crack, and your pains, coſt and time will be loſt, wherefore when they are in this ſtate, let them be kept hot in the fire. Now, when all is cold, put upon 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.

CHAP. XXXIX.

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

How to make Aqua Regis.

CHAP. XL.

TO every pound of the said *Aqua-fortis*, put two ounces of *sal Armoniack* powdered, into a glass body, which set in a pan full of warm water, and let the *Aqua-fortis* be often stirred, w^ch^ will soon dissolve the *sal Armoniack* with it's heat, w^ch^ 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 metalls; but silver it toucheth not at all.

To burn Tartar.

CHAP. XLI.

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

How to make a Calcidony *in Glass very fair.*

CHAP. XLII.

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

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 anorher 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 bottome there will remain a Lion colour, which being well powdered, keep in a glaſs veſſel. When you would make a *Calcidony*, put into a pot very clear metall and made of broken pieces of 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, soot of the Chimny well vitrified two ounces, *Crocus Martis* calcin'd with Brimstone half an ounce, put by little and little all these well powdered and mixed into this glass at six times, expecting a little while at each time, still mixing the glass that the powder may be well incorporated. As soon as all the powder is put in, let the glass boil, and settle 24 hours at least, then make a little glass body of it, which put in the furnace many times, and see if the glass be enough, and if there be on the outside toyes of Blew, and Sea-green, Red, Yellow, and all colours with toys, and it

hath

hath some waves, such as *Calcidony*, *Jaspers*, Oriental *Agats* have, and that the body kept within be as to the sight as red as fire. Now as soon as it is made and perfected, it is wrought into vessels always variegated, which are not to be remade, for they do not arise well. These vessels may be made of divers sorts, and drinking glasses of many fashions, broad drinking cups, salts, flower pots, and the like toyes, 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 toyes of the fairest colours. You may also make with this pot dishes, pretty large in *Oval*, *triangular*, *quadrangular* form, as you will, and afterwards work it at the wheel (as Jewels) for it takes polishing, and a fine lustre, and it may serve for little tables, and cabinets; so that those little Jewels will represent the Oriental *Agat*, *Jasper*, and Oriental *Calcidony*, and when it happens that the colour fadeth, and the glass becomes transparent, and no more Opacous as it ought to be for these works, then cease from working, put to it new *Tartar* calcin'd, soot

and

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

The second Calcidony.

CHAP. XLIII.

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

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

3. In another little glass body, put one pound of *Aqua-fortis*, wherein dissolve two ounces of *sal Armoniack*, 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 Skales of iron that fall from the anvil, of each half an ounce, these swell very much. Let all these 6 bodies stand 12 days, & shake them well six times every day, that the water may penetrate & subtilise the ingredients and metalls, 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 ſoot 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 toyes and wavings, work all of it into veſſels of divers ſorts, framing therewith all ſorts of workmanſhip, and variety of toyes.

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*.

The third way of Calcidony.

CHAP. XLIV.

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

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

3. In another glaſs body, diſſolve in a pound of *Aqua-fortis*, three ounces of fine Silver

Silver calcin'd after this manner, to wit, amalgamate the silver with *Mercurie*, mix the amalgama with as much more common salt well prepared from all 'its 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 grosnes and terrestrity of the salt, evaporate this water filtred from the terrestriety of the salt in a glass vessel, and dry it well, repeat this till the salt sends no more dregs to the bottom, and then it will be perfect and fit for the work. This purifying of the salt is made that it may be more efficacious to open the silver, otherwise it will be hard to separate them. Put all these things amidst the coals, in a pot, that all the *Mercurie* may be evaporated away, and the Silver remain at the 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 chrysible or a pot to calcine six hours in the fire. Wash this stuff in a glased pot many times with warm water till all the saltnes 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 this water dissolve a quarter of an ounce of gold, keep this last solution apart.

5. In another glass body, dissolve in one pound of *Aqua-fortis*, three ounces of *sal Armoniack*. Then put into the solution, of *Cinaber*, of *Crocus Martis*, of *Ultramarine*, of *Ferretto* of *Spain*, of each half an ounce, put them (well powdered) 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 gentlie each of them (ground by themselves)

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 glaſs. In the bottome of this body, will remain a powder of a purpliſh Green, whereof I gave the glaſs ſuch a doſe and quantity as is ſaid in the firſt *Calcidony*. Then in due times (as is ſaid in the firſt *Calcidony*,) give it 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.

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.*

CHAP. XLV.

THis third Book teacheth various wayes, and one better than another, to make all the abovesaid colours; As al-

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

You muſt be exact in the time, quantity, circumſtances, purifying, powdering, 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* Piemont.

4. *The*

4. *The colour muſt be made fuller or lighter according to the works you employ them for, and to heighten them, put in more of the colour, but to make them lighter, put into the pot more* Fritt. *Take ſome 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.*

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 alwayes very fair.

Garnet

Garnat colour.

CHAP. XLVII.

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

Amethiſt

Amethiſt colour.

CHAP. XLVIII.

TAke 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.

Saphyre

Saphyre colour.

CHAP. XLIX.

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

A fairer Saphyre colour.

CHAP. L.

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

A Black colour.

CHAP. LI.

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

A

A much fairer Black.

CHAP. LII.

TAke of the *Frits* of Cryſtal and *Polveverine*, 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.

Another fairer Black.

CHAP. LIII.

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

A fair milk White called Lattimo.

CHAP. LIV.

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

A fair White much whiter than the former.

CHAP. LV.

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

To make a Marble colour.

CHAP. LVI.

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

A Peach colour in White.

CHAP. LVII.

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

A Deep Red.

CHAP. LVIII.

TAke of Cryſtal *Fritt* 20 pound, broken pieces of white glaſs one pound, calcined Tin two pound, mix theſe well together, put them into a pot to run and purifie, when theſe are melted, take ſteel calcined, ſcales of Iron from the anvil, both well ground, of each a like quantity, mix them together, put 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

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

Fritt *of natural Cryſtal.*

CHAP. LIX.

Calcine natural Cryſtal in a Chryſible, extinguiſh it in common cold water eight times, cover the Cryſible 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.

A Pearl colour in Cryſtal.

CHAP. LX.

Put at 3 or 4 times to Cryſtal melted and purified, of *Tartar* well calcin'd to whiteneſs, and continue to put in the *Tartar* 4 or 6 times, always mixing it well with the metall, till the Cryſtal hath gotten a Pearl colour. Then work it ſpeedily, for this colour fadeth. This I have often practiſed and experimented.

The fourth Book. Wherein is shown the true way to make glass of Lead, to calcine Lead, and extract from it the colours of green Emerald, Topaz, Skie colour or Sea green, Granat colour, Saphyre, Gold Yellow, and of Lapis lazuli.

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

CHAP. LXI.

THe glass of Lead known to few in this Art, as to colours, is the faireſt and nobleſt glass of all others at this day made in

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

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

The pots and Lead muſt not have too much heat in the furnace, neither muſt the metall

metall be wrought too hot, and the Marble whereon 'tis wrought muſt be of the hardeſt ſtone, and muſt be wetted, elſe the marble will break and ſcale.

To calcine Lead.

CHAP. LXII.

AT firſt Calcine Lead in a Kil as the potters do, and in great quantity. Uſually in two days they calcine many a hundred pound of Lead. In calcining obſerve that the Kil be not too hot, but ſufficiently heated 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.

CHAP. LXIII.

TAke 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.

CHAP. LXIV.

TO work glass of Lead into divers drinking or other vessels, 'tis necessary before 'tis taken upon the Iron to be a little raised in the pot, and then take it out, and suffer it to cool a little, and then work it on the Marble being clear. At first let the Marble be well wetted with cold water that this glass may not draw away with it the Marble, and scale it; which it always doth when the marble is not wetted, and incorporates it into 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.

Glass of Lead of a wonderful Emerald colour.

CHAP. LXV.

TAke 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 colour, and in few hours 'twill run and become very clear, then give it brass thrice calcined (made as in Chap. 28.) six ounces,

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

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

Another

Another wonderful Green Emerald beyond all other Greens.

CHAP. LXVI.

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

Topaz colour in glaſs of Lead.

CHAP. LXVII.

TAke Cryſtal *Fritt* inſtead of *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, ſeparate the Lead from the pot and glaſs, and repeat this twice, then hereto add half glaſs of a Gold Yellow colour, let them incorporate, and purifie for an Oriental Topaz.

A Sky or Sea-green in glaſs of Lead.

CHAP. LXVIII.

TAke Cryſtall *Fritt* 16 pound, Lead calcined 10 pound, mix and 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.

The colour of a Granat in glaſs of Lead.

CHAP. LXIX.

MIx 20 pound of Cryſtall *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.

Saphyre colour in glass of Lead.

CHAP. LXX.

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

A Yellow Gold colour in glaſs of Lead.

CHAP. LXXI.

TAke of Cryſtall *Fritt*, and calcined lead, of each 16 pound, mix and 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.

The colour of Lapis Lazuli.

CHAP. LXXII.

MElt the faireſt Lattimo made, as in Chap. 55. with the whiteſt Cryſtall and moſt tender, in a pot, when 'tis well

well melted, give it of Blew Painters Smalts, by little and little, and when the colour is good, let it ſtand in the fire two hours, and make a proof, and when 'tis good let it ſtand 12 hours, mix them, and work them. If the metall riſe put in a piece of leaf Gold to diminiſh the riſing. This will be very like the natural *Lapis Lazuli*.

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

CHAP. LXXIII.

TAke natural Cryſtal of a good water, and very clear, free from Terreſtriety, in ſeveral pieces of divers Magnitudes, crude Antimony, Yellow Orpiment of each powdered two ounces, *ſal Armoniac* one ounce, powder and mix well theſe three laſt, put this mixture in the bottom of a Cryſible that will bear the fire, and above this mixture the Cryſtalls in pieces, then cover this Chryſible with another, mouth

to mouth, lute them well, and when they are dry, set them in coals, which kindle by little and little, and when they begin to fire, let them flame of themselves, and then they will smoak much, do this operation in a large Chimney, and avoid the dangerous and deadly fumes, when all these fumes are gone, let the Chrysible stand till the pot cool, and the fire go out of its self. Then unlute the Chrysibles, and take out the pieces of Crystal, and those which are at the top will be tinged with a good Yellow colour, with a red Rubie, and Balass colours with fair spots, those which lay at the bottom upon the powder, and the residence, into the Wavie colour of a Viper. These pieces of Crystall may be wrought as Jewels at the wheel, and will receive a good polishing, lustre and shewing beauty, such as is in the Topaz, Rubie and Balass, 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 beautiful and fair.

The

The colour of a Balass, Rubie, Topaz, Opal, and Girasole in Natural Crystall.

CHAP. LXXIV.

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

Which tingeth the Cryſtall well, and better than when they paſs thorow the joynts of the Chryſibles. When the lute is dryed, ſet them in the coals, ſo that all the lower moſt, and half the uppermoſt be buried in the coals. Then kindle the fire by little and little, do as in the former, and avoid the deadly fumes. The materials fume long, keep conſtantly a ſtrong, and good fire. See you let not in any wind or cold air by windows or other places, for the pieces of Cryſtall being then hot, will become brittle, will ſplit, and not be good. When the fire is gone out of it's ſelf, unlute the Chryſibles, and you ſhall find the greateſt part of the Cryſtall tinged with the true colours of Topaz, Chryſolite, Balaſs, Rubies, Girafole, and Opal with wonderful beauty. Thoſe of the beſt colour may be wrought by the Jewellers, at the wheel, and appear natural jewels, and the Cryſtall holds it's natural hardneſs, which is great. At *Antwerp* I made good ſtore, and amongſt them, ſome of them were of a fair Opal colour, and ſome of the Girafole. You may ſet them in Gold with foiles. Be

ſure

ſure the Orpiment be good, for therein conſiſteth all the ſecret. If the work proceeds not well the firſt time, repeat it a ſecond, and with practice you ſhall always do it without failing.

The

The fifth Book. Wherein is shown the true way to make pasts for Emeralds, Topas, Chrysolite, Iacinth, Saphyre, Garnat, Egmarine, and other colours, of so much pleasantness and beauty, that they surpass the same natural stones in all things, except hardness.

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

CHAP. LXXV.

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

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

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

The way to prepare natural Cryſtall.

CHAP. LXXVI.

TAke 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 Cryſtal doth. The ſaid ſtones uſed to make counterfeit Jewels, though they take poliſhing wonderfully, yet they always have ſomething earthy, and obſcure in them. But 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 Cryſtal, put them in Chryſibles covered at the top, ſet them in burning coals till they be both well heated & fired, then ſuddenly caſt the Cryſtall into a very large pan, full of cold clear water. When the Cryſtal 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 Chryſible, and that the water be always very clean. When the Cryſtal 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 ſercing 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 durty 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 Cryſtal 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 Crystall is calcin'd, and wherein the pasts are baked with lute well dryed, before they be set to calcine or bake.

2. Take pots that will bear the fire.

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

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

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

6. Leave the vacuity of a fingers thickness in the top of the pot, especially where 'tis said it 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 to make Oriental Emeralds.

CHAP. LXXVII.

TAke of Cryſtall prepared two ounces, ordinary Red-lead four ounces, mix and incorporate them well together, good *Verdigreas* two peny 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.

To make a deeper Emerald colour.

CHAP. LXXVIII.

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

To make a more beautiful paſt for Emeralds.

CHAP. LXXIX.

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

Another most fair Emerald.

CHAP. LXXX.

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

An Oriental Topaz.

CHAP. LXXXI.

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

An Oriental Chryſolite.

CHAP. LXXXII.

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

Sky colour.

CHAP. LXXXIII.

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

A Sky with a Violet colour.

CHAP. LXXXIV.

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

An Oriental Saphyre.

CHAP. LXXXV.

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

A deep coloured Oriental Saphyre.

CHAP. LXXXVI.

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

An Oriental Garnat.

CHAP. LXXXVII.

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

A

A Deeper Oriental Garnat.

CHAP. 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.

Another fair Garnat.

CHAP. 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 Pasts and their colours.

CHAP. XC.

OBserve, 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 Grapats 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.

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

CHAP. XCI.

THis way which I have taken from *Iſaac Hollandus*, when I was in *Flanders*, to imitate Jewels, is not much uſed, and known perhaps to few perſons, and though it be ſomewhat laborious, Yet by how much 'tis more laborious 'tis ſo much the fairer; and beautiful, than any made in any place whatſoever to this day, or at leaſt

leaſt not ſhewn to me by any perſon. Wherefore I will ſhew the manner to make them, ſo clearly, and with ſo many circumſtances and obſervations, that any one verſed in Chymiſtry will be eaſily capable thereof, and will do the work perfectly. Take Ceruſs, otherwiſe call'd white lead, grind it very fine, and put it into a great glaſs body, and pour therein as much diſtil'd Vineger as will riſe a palm above it. Obſerve that at firſt the vineger boils and 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 Ceruſs, and evaporate and decant as before. Repeat this till you have extracted all the ſalt from the Ceruſs, which is when the Vineger is coloured no more, nor hath any more taſte of ſweetneſs, which uſually ſucceeds the ſixth time. Then Filtre theſe coloured Vine-

gers

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 glased 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 aboyesaid 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 surpass the forementioned, made with ordinary Red-lead. For this true Sulphur *Saturni* outgoeth all others, more than I write thereof, as I have seen, and often made it at *Antwerp*. Pasts made with this Sulphur, have not that unctuosity and Yellowness, as the other ordinary ones have, which in time shew their foulness, and the moisture and sweatiness which coming from within men much soil them, which happens not to those made with the said Sulphur. Wherefore think not that pains much, which will be well recompensed with the work and effect.

How

How to make very hard paſt of all colours.

CHAP. XCII.

TAke of prepared Cryſtall ten pound, ſalt of *Polverine* ſix pound, made as in Chap. 3. well dryed and ground on a Porphyrie, mix and ſerce them well together, Sulphur *Saturni* two pound, mix theſe three powders in earthen pans 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

moreover this sort of purest glass will be tinged into all colours you desire. For example into an Emerald with Brass thrice calcin'd, as is done in ordinary glass, into a Sea-green, with Brass calcin'd to redness, made as in Chap. 24. and with *Zaffer* into a Topaz, into a Saphyre with *Manganese* and *Zaffer*, into Yellow w^th^ *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.

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.

Enamelling 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-

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.

The Material wherewith all Enamels are made.

CHAP. XCIII.

TAke of fine Lead 30 pound, of fine Tin 33 pound, Calcine them together in a Kil, and 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 grofs 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 bottome much finer than the Ordinary. Take then of this fine Calx, of Cryſtal *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,

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.

CHAP. XCIV.

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

An

An Enamel of a Turcois colour.

CHAP. XCV.

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

Another Azure Enamel.

CHAP. XCVI.

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

A Green Enamel.

CHAP. XCVII.

TAke of the ſtuff for Enamels four pound, put it in the furnace, and in ten or tewlve 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.

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

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

A Black Enamel.

CHAP. 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

Another Black Enamel.

CHAP. CI.

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

Another Black Enamel.

CHAP. CII.

TAke of the ſtuff for Enamels four pound, *Tartar* four ounces, *Manganeſe* prepared two ounces, grind and mix theſe two powders well with the ſtuff for Enamels,

mels, set them in the furnace in a large pot, when melted and refined, cast them into water, and put them into the furnace again, let them refine. This is a most fair Velvet Black to Enamel upon metalls ordinarily.

A Red Enamel.

CHAP. CIII.

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

A Purpliſh Enamel.

CHAP. CIV.

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

A Yellow Enamel.

CHAP. CV.

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

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

A Sky coloured Enamel.

CHAP. CVI.

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

A

A Violet colour'd Enamel.

CHAP. CVII.

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

The seventh Book. Wherein is shown the manner how to extract Yellow Lake for Painters, from Broom flowers, and all other colours, with another way to extract Red Lake, Green, Azure, Purple, and all colours from all kindes of Herbs and Flowers.

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

IN this Book is shown the way to extract all colours from Flowers and Herbs,

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

A Yellow Lake to Paint, from Broom Flowers.

CHAP. CVIII.

MAke a Lee of Barillia, and of Lime, reasonable strong; and in this Lee, boil

boil at a gentle fire fresh Broom Flowers, that the Lee may draw to it all the tincture of the Flowers, which you shall know by taking the Flowers out and seeing them white, & the colour well taken out, and the Lee will be yellow like good *Trebian* wine: then take out these Flowers, and put this Lee in earthen dishes (glased) to the fire, that the Lee may boil, and put into it, so much Roch-Alum, that with the fire, all the Alum may be dissolved; then make a fire, and empty this Lee into a vessel of clean water, and it will give a Yellow colour at the bottom: let them settle, and decant off all the water, and again put upon them other fresh water, and decant it off; let the tincture first sink to the bottom, and do this so long, till you have taken out all the salts of the Lee and Alum from the tincture; observing that by how much the more you wash this tincture from the salt of the Lee and Alum, by so much more will the tincture of the colour be fairer, and more beautiful, washing it always with water to carry away the salt of the Lee and Alum, and at each time before you decant the water, let the Yellow tincture settle to the

bottom. 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.

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

CHAP. CIX.

GEt what quantity of the leaves of Flowers of what colour soever they be, let every colour be by 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

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, Pimpernells, and all other Herbs.

CHAP. CX.

TAke of whatſoever Herb, or Flower, of whatſoever colour you will, which being bruiſed green upon a leaf of white Paper, tinges it with 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 vitæ*, the head muſt be as large as poſsible, and in the top thereof put the leaves of whatſoever Flower or Herbs, from which you would draw a tincture, then lute the joynts of the head, and thereto fit a receiver, then

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

A Blew to make.

CHAP. CXI.

TAke Quick-silver two parts, flour of Brimstone three parts, *sal Armoniack* eight parts, grind them all upon a Porphery, and with the Quick-silver, put them in a glass with a long neck luted at the bottom

tom in sand, make a gentle fire till the moisture rise, then stop the mouth of the glass, and increase and continue the fire, as in sublimation, till the end, and you shall have a Blew, most fair and excellent.

How to colour natural Turcoises *discoloured.*

CHAP. CXII.

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

A mixture to make ſphears.

CHAP. CXIII.

TAke 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 *Tartar* 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 burniſhed 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.

CHAP. CXIV.

TAke a Ball, or other sort of glass that is white & fair, & Isinglass which must be infused two days in common water, then put this infusion into a white pan with fair water, and boil it till all be well tempered, observing that the Isinglass will be very tender with much water, then take it from the fire, and when it is warm, put it into a Ball of glass, & turn the glass round, that the Isinglass may fasten and wet every where the glass within, this being done let the moisture drain and run out, then have in order these colours powdered, to wit Red-lead, and casting it into the glass it will make the said colour stick (which will run in waves) cast it into many places through a tube, then throw in blew smalts making

it ſtick in waves, within the Ball. Then do the ſame with Verdigreas, then with Orpiment, next with Lake, all well ground, always caſting the colours in many places in waves, which by means of the Iſinglaſs which hath moiſtned the glaſs within, thoſe powders will every where ſtick to the glaſs; and ſo ſhall you do with all colours. Then take Geſſo well powdered, and put enough thereof into the Ball, and 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 dryed) 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-

Ultra-marine.

CHAP. CXV.

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

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

Take for every pound of *Lapis Lazuli* ground as before, ten ounces of the aforesaid past of gums, which dissolve in a Pipkin

Pipkin at a gentle fire, and when it is well dissolved, cast in by little and little, the said powder of *Lapis Lazuli*, and incorporate it with the gum with a Spatula, I cast all the materials thus hot being incorporated suddenly into cold water, and bathing my hands with Linseed Oyl, made a round pastill hereof long and proportionally thick. Of these pastils you may make one or more according to the quantities of the materials, keep these pastils fifteen days in a great vessel full of cold water, changing the water every two days, then shall you boil in a Kettle common clean water, the pastils in clean and well 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 cleansed. This casting on of warm water upon the

the pastils, must be repeated till it be no more coloured, but observe that the water be not over hot, but luke warm 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 Porphyrie to an impalpable powder, and incorporate it with the gumm paſtils with the foreſaid quantities, keeping them indigeſtion in cold water 15 days with *Lapis Lazuli*, and work thorowout as in *Lapis Lazuli*, you ſhall have a very fair and ſightly Blew Bice, which will ſeem to be an *Ultramarine*. Theſe Blews not onely ſerve for Painters, but to colour glaſs excellently.

A Lake from Cochineel for Painters.

CHAP. CXVI.

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

Take four ounces of Roch-alum, two ounces

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

A Magistery to extract the colour from Cochineel.

CHAP. CXVII.

COld 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 Brass Mortar, powder and serce one ounce of Cochineel, so many times, till all pass 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 whil'st 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 abroad

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

Take ashes of Vine branches, or of Willows, or of other soft wood, put them upon doubled Canvas, and pour gently on them cold water, let the water run into a pan, pour twice this strained 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 a most gentle fire, for so the Lee will be tinged with a Red colour, and will draw the tincture from the Flox, and at first take a little Flox and press it well, and if the colour be discharged, take the pipkin from the fire, and this is a sign that the Lee hath drawn the tincture of the Cochineel from the Flox.

Hang an *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 glass of cold water, let them stand till all the Alum is dissolved, then fitly place the said bag well washed from the hairs of the Flox betwixt two sticks in the air. The bag must be large at the mouth, and narrow at the bottom, sowed in the manner of a round pyramid, and under the bag set a clean pan, then cast all the Alum water into the pan where the tincture of Cochineel is, and you shall see the Alum water suddenly separate the tincture from the Cochineel like as a Coagulum doth. Then with a clean dish cast into the bag all the said tincture and Lee, which will run clear out of the bag, but the tincture will stick to the bag. And when all the water is well 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

cture in the bag, and the Lee will then run white and discharged of tincture. Then take clean sticks, and therewith mix the tincture which sticks on the bag in gross pieces, and have in readiness new baked bricks, whereon spread little pieces of 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.

Lake of Brasil and Madder very fair.

CHAP. CXVIII.

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

Lake from Cochineel after another and more easie manner.

CHAP. CXIX.

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

In a pottle of *Aqua vitæ* 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 vitæ* will be wonderfully coloured, let them stand four days, then empty this stuff into a clean earthen glased pan, then dissolve four ounces of Roch-alum in common water, cast this into the pan of *Aqua vitæ* coloured with

Cochineel, and put this into the *Hyppocras* bag, and so proceed throughout as in the 117 Chap. This is a most noble Lake from Cochineel, made with small pains, and in much greater quantity. All this was tryed at *Pisa*.

A transparent Red in Glass.

CHAP. CXX.

TAke *Manganese* ground to an impalpable powder, mix it with as much more refined Salt-peter, set it to the fire in an earthen pan to reverberate and calcine 24 hours, then take and wash it with common warm water from 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 residence, weigh them and add as much *sal Armoniack* as shall be wanting in this first sublimation, grind them all together on a Porphyrie, imbibing them with distilled Vinegar, then sublime them in a retort as before, and this sublimation is to be repeated after the same manner so long till the *Manganese* remain all at the bottom fusible.

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

A Red as red as Blood.

CHAP. CXXI.

PUt six pound of glass of Lead, common glass ten pound, into a pot glased 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.

The colour of a Balass.

CHAP. CXXII.

Put Crystall *Fritt* in a pot into a furnace, cast it thrice into water, then tinge it with *Manganese* prepared into a clean purple, then take *Alumen Catinum* sifted fine, put in thereof so much as will make the glass become purple, and this you shall do eight times, and know that Alum makes the glass grow Yellow, and a little Reddish, but not blakish, and it always makes the *Manganese* flie away; and the last time that you add *Manganese*, give not the glass more Alum except the colour be too full, and so you shall have a most fair *Ballas* colour.

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

CHAP. CXXIII.

Put Litharge well ground into an earthen pan well 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 glass in many things, and if this white stuff precipitate not well, cast upon it cold water, which is wont to make it fall to the bottom,

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

A fair Red to Enamel Gold.

CHAP. CXXIV.

TAke 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 glased 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.

A fair Red for Gold after another Manner.

CHAP. CXXV.

TAke 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 Hæmatites*, wherewith the Cutlers burnish, and of fixed *Sulphur*, of each one *Drachm*, mix and incorporate these powders, and see if the colour be too deep, give it a little *Manganese*, which makes it lighter, and if it be too light a colour give it fixed Sulphur, and *Lapis Hæmatites*, and a little of Copper calcin'd to Redness, and a little *Tartar* of white wine with discretion, and do this till it come to the desired colour.

To fix Sulphur for the work above-said.

CHAP. CXXVI.

BOil Flowers of Brimstone in common oil an hour, take them from the fire, and cast upon them the strongest Vinegar, and the Sulphur will sudddainly 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.

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

CHAP. CXXVII.

MElt in a pot of glass of Lead six pound, Crystall *Fritt* ten pound, cast them when refined into water, put them again into the pot, when they are well refin'd 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, wch incorporate with the glass, let them refine, and see if the colour please you, and if it be not heightned with the Copper, and *Tartar*, put it again to anneal till it come to be sufficiently Red, this is done to heighten the colour.

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

CHAP. CXXVIII.

TAke of Cryſtall *Fritt*, boil it as in Chap. 124. ſix pound, refine it well in a 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 ſoot of the Chimny well vitrified, and with theſe powders mix half an ounce of the ſaid *Crocus Martis*, put theſe pow-

ders

ders well ground into the glaſs at four times, mixing them well, and interpoſe a little ſpace between each time, for they make the glaſs ſwell and boil exceedingly, when all the powder is put in, let the glaſs refine three hours, then remix them, and take a proof, to wit, a little Bowl of glaſs, and ſcall'd it well, if it take a tranſparent Red, as blood, it's well, if not, give it new *Tartar* burnt with ſoot, and *Crocus Martis*, by little and little, till it come to the deſired colour, let the glaſs ſtand to ſettle, and an hour after you put in the powder, take another proof as before. This is good to Enamel, and proved often times at *Piſa*.

A transparent Red.

CHAP. CXXIX.

CAlcine Gold with *Aqua-regis*, many times, pouring the water upon it five or six times, then put this powder of Gold in earthen pans to calcine in the furnace till it become a red powder, which will be in many days, then this powder added in sufficient quantity, and by little and little, to fine Cryſtall glaſs which hath been often caſt into water, will make the tranſparent red of a Rubie as by experience is found.

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

CHAP. CXXX.

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

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

CHAP. CXXXI.

SEt Chrysibles 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 Chrysibles, 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 acros, fill the pans with kindled coals, and put in the aforesaid calcin'd Brass, 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 hoock at the top, that it may not stick, nor cleave to the pans; continue this

this till all the Sulphur be burnt and ſmoak no more, then take the pans from the fire thus hot, and all the Copper, with an Iron ladle or like thing, powder it well in a Braſs morter, and ſerce it, which will then be a black powder, proceed thrice with the ſame quantity of Copper and Brimſtone in every thing as before. Obſerve, that at the third calcination you let the pans ſtand over the fire, ſo long that the Copper acquires a red Lion colour, then take it from the fire, and powder it in a Braſs mortar, and you ſhall have the ſaid colour to make the ſaid Vitriol as we are about to ſay.

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

CHAP. CXXXII.

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

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 Filtre the ſaid water with uſual linguets into glaſs veſſels, and evaporate from the ſaid Copper all the moiſture, and with ſix ounces of Sulphur calcined, powder and 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 whil'ſt it is hot, is, becauſe then it is better ſeparated from the pots, & it is impoſſible to ſeparate it, if you ſuffer it to be cold, although you break the pots. Repeat this proceſs not 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 Filtred waters, all which mixed

together must be Filtred with the usual linquets, 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.

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

CHAP. CXXXIII.

SEt then a great glass body that will hold three Flasques of liquour in ashes or sand in the furnace, and with a temperate fire evaporate the said colour'd waters, and neer to the furnace keep other glass bodies full of these colour'd waters, that they may be warm, and now and then fill the great body, which is in the sand with glass ladles, do this that the colour'd waters may be put in warm, for being put in cold they will make the great glass body break; evaporate the colour'd liquour from ten Flasques to two and a half or three, then these waters will be deep and full of 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^ch^ 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.

FINIS.

AN INDEX.

Tur-

Colours to make.

Tran-

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* Bornetius de ſufficientia, *Pag.* 141. *Neither could I ever find by ſtrict inquiry that the other piece promiſed in the Epiſtle Dedicatory, and the Preface, concerning* Chymical *matters, was ever publiſhed, neither have I read in any* Spagyrical *writers quotations drawn thence. Wherefore I may eaſily conclude, that it never came to light; and it is no wonder he found no incouragement 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 uſeleſs, or indeterminable, moſt of whoſe notions were bare* λογομαχίαι. *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 & inefficacy 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 experimently 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 Glas*; *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 Glas*, & Mela, lib. 3. cap. 6. Britanni vitro corpora infecti, *and* Vitruvius, *wooll died with Glas*, *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 Glas*, *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 fasly puts* Guastum *for* Glastum, *because the* Britans *continually call it* Guadum, *The which call a Blew colour Glas*. *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 wholy of Art, not of Nature, and not to be produced without ſtrong fires. I have heard a ſingular Artiſt,*

Artists merrily to this purpose say, that their profession would be the last in the world: for when God should consume with fire the Universe, that then all things therein would vitrifie and turn to glass. Which would be true upon supposition of a proportionable mixture of fit Salts, and Sand or 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. 11. *calls it a stone*, Fallopius *reckons it amongst the* Media mineralia, *and the workmen, when it is in a state of fusion call it metall. But to me it seems neither of these, which this generall Argument sufficiently evinceth, that all the aforementioned 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*

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 homegeneous: 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

ther places, yet he saith that ashes is added nstead of Nitre which the Antients used, that hey might more easily extract Glass from the Metalline stone. Yet we may not say that ashes s mixed with the Metall to make Glass, but hat 'tis onely put into the furnaces where Glass is melted, that Glass may be more easily duced from the smallest and inmost particles f the Glass-stone, that is, of it's proper Me- all; so far he. But this strange opinion is easily onfuted; for if Glass were extracted from he stones onely, then the weight of the Metall nust needs be far less than the stones alone, but in truth the weight of the Metall far surpasseth hat weight, for 100 weight of Sand yields a- ove 150 of Metall; besides, the Salts compo- ng Glass are the most fixed salts, which the re cannot raise with the most vehement heat. Again in old windows of French Glass, in hat 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 poyson. 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 alkali quis colliquaverit ac humido loco exposuerit, reperiet mox totum vitrum resolvi in aquam, cui si affundatur Chrysulea, addito quantum saturando alkali sufficerit, inveniet statim in fundo arenam sedere eodem pondere quæ prius faciendo vitro aptabatur. *If you melt fine flour of Glass with good store of* Sandever, *and set them in a moist place, you shall soon find all the Glass resolved into water, whereunto if you pour as much* Aqua-fortis, *as will suffice to saturate the* Sandever, *you shall find the sand presently settle to the bottom in the same weight which was put in at first.*

And in this experiment the salt is imbibed, 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 Glass,

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 britle as glass.*

10 *'Tis diaphanous either hot or cold.*

11 *Tis*

11 *'Tis flexible and hath in threeds* motum rectitutionis.

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 fit for Painting than any other thing.*

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

21 *It may be melted but 'twill never be calcined.*

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 asunder 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 liquour frisk and leap.*

Antiquity of Glass.

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

Crystall, 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* Pagninus *from* Rabbi Levi Kimhi.

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

Glass of Crystall, Vitrum Crystallinum, Complutensis.

A Beril, *as* Vatablus.

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

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

The reason of this difference in the translators, is, because the Original word Zechuchih *comes from the root* Zacac *which signifies to* purifie, *to* cleanse, *to* shine, *to be* white, *and* transparent. *The same word is applied to* Frankincense, Exod. 30. 34. *and is*

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* Glass *nor* Crystal, *because 'twould seem incongruous, that those of so mean a value should be brought into comparison, the former being made of Materials very common, and the latter could not but be vulgar. Besides, 'tis probable this word subjoyned to* Gold, *was added after it for amplification. Add hereunto, that Glass is no where mentioned in the* Old Testament, *though frequently in the* New *by S.* Paul, *S.* James, *and in the* Revelation. *And indeed who can imagine that a thing fit for so many illustrations, and comparisons, and of so common use, could be passed by in silence, if known, by the Scripture so full of elegancies in this kind? And therefore I judge it meet to keep the general word, and not to confine the sense to one pretious and*

tran-

transparent stone, or thing, but to extend it wider to all things that have those two properties in them. But too much of this in messe aliena.

Aristophanes *seems to be the first that mentions this word* ὕαλος, *now rendered* Glass; *for in* Nubibus, Act. 2. Scen. 1. *he brings in* Sthrepsiades *abusing* Socrates, *and teaching him a new way to pay old debts*, viz. by placing a fair transparent stone sold 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 ὕαλος. *Whereon the* Scholiast *thus*, Druggists sold precious stones as well as Medicaments. *And that the* Antients *call'd* χρύον, (*the same with* χρύσταλλος) 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* ὕαλος, *in this sense, but* Hyalen, Hyalon, Hyaloen, shining *and* Diaphanous.

nous. *The* Etymologist *hath it in this sense and fetcheth the* Etymon *from* ὕειν, *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* ὕαλος, *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* Sympoſiack, *saith*, that fire of Tamarisk wood is fittest to form Glass.

That the Egyptians *were skilfull in this Art, appears by* Flavius Vopiscus, *quoted by* Marcel. Donatus, *in these words*, Alexandria a City rich, fruitful, wherein 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* Antient *as* Potterie *it self, or the* Art *of making* Bricks, *for scarcely can a Kill of* Bricks *be burnt, or a Batch of* Pottery *ware be made, but some of the* Bricks, *and ware will be at least 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 hoth 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, indeavouring at an universal Medicine, but not the supposed transmutation of Metalls, 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 Glass.

IN Domestick affairs it makes drinking vessels, infinite in fashion, colour, largness, the Romer *for* Rhenish *wine, for Sack, Claret,*

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

n the Vulgar beholder, as you may see in Schottus Opticks, Catopticks, Catoprocausticks, 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.

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

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

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

In Philosophy the Doctrine of Reflections, and Refractions, to discover the effects, and affections of air and water, and other liquours, and their various motions, in Tubes *and* Syphons. *Experiments of a* vacuum *with* Mercury, *as also infinite experiments of rarefaction and condensation, in* Thermoscopes, *in the* Hydraulicks, *and* Pneumaticks,

in

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 Embassadours 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, aud 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 ſtai'd 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 metalls of Brass, Silver and Gold, and this report was more common than certain. *Now* Pliny *liv'd in the time of* Vespatian, *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*, Pancirollus *and others follow, onely telling it as a hear-say; but* Matthesius, Goclenius, Valensis, 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* ferunt, *they report, and with a* fama, *the report was, and thirdly*, 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 ferunt, *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 matterials 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* Plinyes *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 flexibile effet, *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 metalls malleable. A green stick,* Muscovie Glass, *and infinite other things will bow very much, whereon the Hammer, notwithstanding, hath no effect as to dilatation, and formation into thin plates, such as things call'd properly malleable have. And that Glass is in some degree flexible of 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 whereas their Glass before this time was most brittle, as being made of Salt-peter, and the art of annealing it (not mentioned by* Pliny*) unknown and consequently must break with the smallest force; Now this Artist might invent and shew such Glass as might accidentally bear a fall, or greater force, than what was formerly made, by making it of* Kali, *and superadding the way of annealing it. Which might give occasion to fame, 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 resistence, 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 adhæsion 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 matterials of Glass, Sand, and Salts, have such figures as seem incapable of such adhæsion 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 causticknes 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, whith is necessary to denominate Glass, but wholly incompatible with* malleability. *And this union is that which makes in Glass Pores, from whence comes it's* diaphaneity *as you have heard from* Lucret. *Besides something said before, declares that they both remain the same in the compound they were before. I shall conclude this argument, and say, that I conceive that nothing but the* Elixir *will perform this effect, and that both of them will come into the world together.*

Of the Furnaces.

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

of the 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 *Halsinella's* which are certain hooks, fastened to the sides of the *furnace*, whereon to rest and turn their vessels when they scald them. 2. *Boccarellas*, one on each side of the *Bocca*, lying almost *Horizontally* with it, out of these the *Servitors* take coloured or finer Metall from the piling pot. 3. Ovens or holes next the *Leer* to calcine *Tartar*, *Iron*, *&c.* One on each side lying level with the *Bocca*. To this also belong the fire place, having two *Tizzonaios* or stitches, one on each side of the furnace, by which a *Servitor* night and day puts in Coals to maintain this *Vestal fire*. These are made with Bricks.

These *furnaces* are variously made in several places, and to strengthen them are arched with five or more arches, yet all three

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 thiek, in the midſt whereof, and in the ſame perpendicular with that of the ſecond *furnace*, there's a round hole (*Imperat.* and *Agric.* make it ſquare and ſmall) through which the flame and heat paſſeth into the *tower*; this hole is call'd *Occhio* or *Lumella*, having an Iron ring encircling it call'd the *Cavalet or Crown*, on the floor or bottom of this *tower* the veſſels faſhioned by the M^rs 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 *Saroſel*, and the *Sarole*-men thoſe who draw the *Fraches* along the *Leer*, and take them thence.

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

The ſtones wherewith the inſide of theſe

furnaces

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 Glass* 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 Glass, which take from *Agric. de Metall l.* 2. with some additions. The *Servitor* when the Metall is sufficiently refined, puts his hollow Iron into the pot, and turning it about, takes out enough for the vessel or work 'tis intended for, the Mettal sticks to the Iron like some glutinous, or clammy juice, much like but more firmly than *Turpentine* or *Treacle* taken

taken by tradesmen out of their pots. The figure it takes on the Iron, is roundish, and whil'st 'tis red hot the *Servitor* rouls it to and fro on a Marble that the parts thereof may be more firmly united; And then gently blowing into his hollow Iron raiseth the Metall just as blowing doth a bladder or glove. As often as he blows into the Iron (and that must be very often) so often he removes suddenly the Iron from his mouth to his cheek, lest he should draw the flame into his mouth, when he reapplies it to the Iron. Then he takes his Iron and whirls it many times about his head, and so lengthens and cools the Glass, and if it be needful for his designs, moulds in the *stampirons* or flats the *bottom* by pressing it on the Marble; And then delivers it to the Master workman, who with a gentle force breaks of the *collet* (which is that part of the Glass which cleaved to the *blowing Iron*, and casts by to make Green Glass) and with his *ponteglo* sticks the Glass and scalds it, and with his *passago* makes the boul 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) *amplyfying*, *cutting*, &c. frames it into the ſhape preconceived in his mind. And when need requires faſtens on feet and handles, and with the *Spiei* puts on *Rigarines* and *Marblings*, and when the Maſter finiſheth them another *Servitor* takes them, with an Iron fork, and ſpeedily placeth them in the *tower* to anneal, mounting up by a ſtep for the more convenient placing of them, unleſs by a ſtumble in the way he chance to break this ware, then moſt brittle and tender, nay, that will break of it's ſelf without this annealing. So many Maſters as there are ſo many pots at leaſt, and ſo many *Boccas* or holes there muſt be, for each man hath his proper ſtation. Where they receive thoſe ſcorching heats ſallying directly into their faces, mouths and lungs, whence they are compell'd to work in their ſhirts like the *Cyclopes* and *nudi membra Pyracmons*, with a ſtraw broad brim'd Hat on their heads to defend their eyes from excedency of heat and light. They ſit in wooden large and wide Chairs with two long Elbows, where-

whereon they hang their instruments, fastned 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, whil'st 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 fudled with wine or bear. A very true Character of them.

Obserua-

Obſervations on the firſt Book.

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

Polverine or Rochetta, *are the ſame thing, and are nothing more than aſhes extracted from the ſame plant, but differing in goodneſs, as appears by our Author in ſeveral places. The name of the latter is wholly unknown to our Glaſs-houſes, and hath now no diſtinction at* Moran *it's ſelf. The name of* Polverine *ſtill is kept, and 'tis given to all aſhes which come from the* Levant *to make Glaſſes with. The reaſon then of their different names ſeems to be, that the* Polverine *was that which was brought in ſmall powder, and the other in hard pieces or ſtones, and therefore named* Rochetta. *And indeed the workmen obſerve that the harder and bigger lumps yield a whiter and ſtronger ſalt than that which comes over in ſmall pieces or powder. And whether this*

this proceeds from the different sorts of this kind of plant, or the seasons of their growth, gathering and burning, or from some sophistication from other salts mixed therewith, or rather from Sea-salt water, or other moysture 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* Lusitanus, *the two latter whereof confidently assert it to be the* Anthyllis *of* Dioscor. *both which* Mathiolus

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 taste, and* Glass-weed, *because the ashes of it serve to make glass with.* Parkinson *saith, that 'tis call'd by the inhabitants of our Sea-coast*, Frog-grass, *and* Crab-grass, *perhaps because those animals feed thereon, being a very juicy, substantial, and not of an unpleasant saltish taste.* Gaspar Bauhin *in his* Pinax *makes ten sorts thereof, whose names and descriptions we omit, as too long for this place. I shall onely mention those three wherewith the* Alexandrians, *and other* Egyptians *make their* Polverine *for Glass, and Soap, as* Alpinus chap. 42. *delivers them. The first is* Kali geniculatum, *the second sort*

Kali

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* Glass-house *taught me, for ours being put upon an Iron heated red hot smoaked all away, leaving little or no ashes at all thereon: But the* Kalies *brought from the* Levant, *put on the same Iron, soon converted almost all of them into a very saltish ashes of a dark ash their proper colour, these in burning contracted themselves like worms, flame long, and make a white and very strong salt. Our* Kali *when gathered appears to the taste 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 denizens of the water, and flourishing naturally neer salt lakes, yet are planted on land in* Spain *and* Egypt, *which doubtless contributes much in those hot regions (especially in* Egypt *where no rain falls, but the 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 dryed in the Sun, and then burned, being laid in cocks or piles, either upon the ground, or upon Iron grates, the ashes whereof fall thence into*

a

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.

Chap. 1. TO know the quantities and strength of the Salt. *The best and readiest to know this, is that practised by the* Soap-boylers, *in their* 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* Verdigreas. *And therefore here they use onely Boylers lined on the inside with* Lead, *such as the* Alume *and* Copperas *makers employ to extract their Salts in.*

Tartar of red wine Calcin'd. Tartar *call'd by our Author* Greppola *and* 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* Crystals *and* Cream *of* Tartar, *larger, and whiter, they powder it grosly, 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 fæces of the* Lees *have setled to the bottom of the* tubs, *they draw them off with a* Siphon.

Chap. 2. TArso. *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, *rendred* Pibles, *which* Ferant. Imperatus, l. 24. c. 16. *thus describes*, The Glass 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 it's 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 Crystall Metall. But the great charge in preparing them hath deterred the owners of our Glass-houses from farther use of them.

Sand *is made use of where fit stones cannot be had, and according to our Authors story, were first used; it must be white, and small and well washed before used, which is all the preparation of it. Such is usually found in mouths and sides of Rivers; for 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. l. 2. c. 9. of the wars of the Jews *relates strange things of* Sand, *which is briefly thus. Neer* Ptolemais *a city of* Galilee, *runs the river* Belus, *arising from mount* Carmel *between* Ptolemais *and* Tyrus. *Neer this small river is the Sepulchre of* Memnon, *having neer it a space almost of* 100 *cubits most worthy of admiration. For there's a valley round in shew, sending forth*

Sand

Sand for Glass, which when many ships comming 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 fos. *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* Syderea, *as a third ingredient into Glass.* Constat (*saith he*) Vitrum ex tribus, *to wit, of stones or sand, of the salt of* Cali, *and* Syderea; *but the small quantity of* Manganese *added to the metall, can contribute little to a pot of metall. Besides 'tis not used in all sorts of Glass.*

Chap. 3. *Shews but the common way of Chymists, by solution, filtration, and coagulation to make fixed Salts.*

Chap. 5. Must 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* Chamapeuce *I keep in my* horto sicco, *all whose branches, and betwixt each leaf thereof are multitudes of round and brownish seeds. How much also the seasons of the year difference* Vegetables, *the* Button-mold-makers *can inform you, in those woods they make* molds *of, who find that* Pear-tree *cut in Summer works toughest, but* Holly *in the Winter,* Box *works hardest about* Easter, *but mellow in the Summer,* Hawthorn *works mellow about* October, *and* Service *tough in the Summer.*

Chap. 6. GIves *an account of other plants, which yield a* Salt *fit for Glass. In one word, whatsoever* Vegetables *afford quantity of* Alcalazite *salts (for so the* Chymists *call such as will persist in, and bear a strong fire, without flying away, and vanishing in the air, and are so denominated from* Alkali, *that is Salt drawn from* Kali) *are good to make Glass. Some whereof this* Chapter *enumerates.* Kelp *so named from* Kali, *and pot ashes are used for* Crystalline *metall.* Kelp *is principally made of that Sea-plant we call* Sea-thongs *or*

Laces, *and from it's uſe by* Joan. Bauh. lib. 39. c. 2. de Hiſt. plant. Alga anguſtifolia vitrariorum, *which being kept moiſt a little after gathering, will ſhew afterwards, though long kept, it's white ſalt on the ſurface of it's leaves.* Math. in Dioſc. *calls it* Algam vulgarem Venetorum, *the common* Sea-wrack *of the* Venetians, *not 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* Ruſſia, *and* New-England, *and are the aſhes for the moſt parts of* Firs *and* Pines. *For Green-glaſſes in* England, *they buy all ſorts of aſhes confuſed one with another, of perſons who go up and down the*

Coun-

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 forementioned are all bitter herbs, as* Hops, Worm-wood, Carduus benedictus, Centauries, Gentians, Southernwood, Tansey, Woad, &c. *could store of their ashes be procured at small charges; add to these* Tobacco, *which affords abundance of Salt, the stems being gathered and burnt, and might turn to great profit, though some damage to the soil. A Merchant told me, he offered to King* Charles *the first, that he would erect and maintain at his own charges Churches, and endow each thereof with* 100 per annum, *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* Spurges, *and* Fig-tree, *which have a Blistering faculty in them, and the* Vine-branches, *and* Sow-thistles, *which are somewhat prickly and downy flower'd, wherein they agree with thistles, and have a milky juice, as* Tithymals *have. Now concerning these fixed Salts, observe, that those are best, which are freest from earth, sticks, and all other* Heteregeneous 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 circiter pedales. *Where he expounds* Clavola *by tender branches.* Nonus *reads it* Clavula, *and defines them the cutting of wood. Certain it is that* Clavola *or* Clavula *comes from* Clava *which is our* Club *in* English. *Fourthly, These Salts must be kept dry, for moysture, 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 schides and burnt within doors. So far* Agric. *But time and experience have worn out the use of* Salt-peter, *and* Fossil *Salts, which have given the priority to* Polverine, *being too soft and gentle, whereas Glass requires* Lixivial, *and fixed Salts, that have a* Caustical, *and strong tast, and but little* Unctuosity, *whereof* Nitre *and* Fossil *Salt have store, and therefore run most of them into* Sandever, *unto which* Nitre *comes somewhat neer in tast and fattiness. But* Agric. *and other Authors seem to mistake* Pliny, *who puts* Nitre *for those* Alcalizate *Salts, for so* lib. 31. cap. 10. Quercu cremata 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.

Semina vidi equidem multos medicare se-(rentes
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 saturare fimo pingui pudeat sola; neve
Effetos cinerem immundum jactare per (agros.

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

As Mr. Ogilby *well renders them. Now these latter verses manifestly prove that salts enrich the soil, and therefore it seems that* Nitre *in the former verses must 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* Sandever, *being put into the* Furnaces.

Chap.

Chap. 7. SAlt 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* Alume, *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. FRit, *seems to be derived from* Frittare *to* Fry. *For 'tis nothing else but salt or ashes fryed or baked together with sand, and so the* English *call the whole quantity baked at a time in the* Calcar *a batch. And secondly, the* Frit *melted runs into lumps like* Fritters *call'd in* Italian Frittelle *or little* Frits. *'Twas by some anciently call'd* Hammonitrum, *and by others more agreeable*

greeable to Etymologie Ammonitrum, *compounded of* ἄμμος, *sand, and* νίτρον, Nitre. *For so* Pliny, lib. 36. cap. 26. *Fine sand from the* Vulturnian *sea is mixt with the weight or measure of three parts of* Nitre, *and being melted 'tis carried to other* Furnaces. *There a mass is made which is call'd* Ammonitrum, *and this being reboil'd makes pure and White glass; and* Cæsalp. *more expressly,* Ex arena & nitro fit massa quam Plin. Hammonitrum appellat, hodie Fritta dicitur, *of sand and* Nitre *a mass is made which* Pliny *calls* Hammonitrum, *but at this day 'tis called* Frit. *This making of* Frit *serves to mix and incorporate the materials well together, and to evaporate whatsoever superfluous* Humidity *they contain in them. Green-glass* Frit *compounded of grosser materials requires* 10 *or* 12 *hours baking more or less, according to the goodness, softness of the sand, and ashes.*

We have three sorts of Frits. First of Crystall *for* Crystall *metall made with salt of* Polverine *and sand. The second and Ordinary* Frit *is made of the bare ashes of* Polverine *or* Barillia *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*

within few days, if need requires it, though the latter of these two must needs conduce much to the puritie of Glass.

Chap. 9. THe quantity of the Manganese, &c. *the reason whereof is because the colours to be put in are of various goodness, some higher, and others lighter, especially the difference of* Manganese *and* Zaffer, *is so great, that some thereof is good for little, other very rich, some of a middle nature, and to know their difference in goodness, there's no way found out but tryall in the furnace, neither in our Glass houses, nor in pottery where they have very great use of both. Besides, the 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. As* sh *indeed affords a most pleasant fire, but soon decays, and therefore unless a continual supply be made, the metall will not be kept melted, nor fit to work.* Camer. *in* horto *deservedly commends Juniper as a most lasting and strong, and sweet fire, could plenty thereof be had. I know not therefore what* Pliny *means, who* l. 36. c. 24. *saith,* levibus vitrum aridisque lignis coquitur. *Glass is boil'd with light and dry wood. Nor why* Plutarch *should say, that* Tamarisk *is fittest to form Glass: for certainly so great a fire as Glass requires cannot be made with such woods. One effect of the fire mentioned by the* Arabian *physicians, and from them by others, I may not omit,* viz. *the burning of Glass mixt with sponge, which being calcin'd they commend to break the stone in the* Kydneys *and* Bladder, *and for outwards* Ulcers, *But the ways to burn it, taught by them, are wholly unfit, and 'tis most certain that the*

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 Sandever. *'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 compell'd to fill the pot four or five times with more fresh ashes, by reason of the quantity of* Sandever *that is in them, before the pot will be filled with metall. 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 metalls run, and a little thereof put into* Antimony *and* Salt-peter, *for making* Crocus Metallorum, *encreaseth the quantity of the* Crocus, *and 'twill therewith separate better from the* Scoria. *'Tis sold into* France, *and there used to powder their meat, and to eat, instead of common salt; a solution hereof bestowed on garden-walks destroys both weeds and vermin.*

Necks of the Glass, *are also call'd* 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. CAlcine 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. TArtar in great lumps. *Because this comes from the strongest Wines, and hath suffered no damage by salt water, or any other, which dissolve it into small pieces, and draw from it some of it's strength. They calcine it in a place made for the purpose neer the* Leer *of the furnace, on either side of the utmost working holes, in six hours time, and that to whiteness too, which worketh all the effects in Glass with us, better than a lower calcination doth.*

Chap. 12. ZAffer *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 other 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 Cærulei coloris quam Zapheram quidam appellant. *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 cœruleo & si plusculum addatur inficit nigredine, 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 calcin'd into good colours for the uses they are emploi'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 bubles, solution, or tincture. Both which experiments I tryed with ordinary* Aqua-fortis *and spirit of* Vitriol, *and could not perceive the least buble arise, nor smallest motion of these liquours, nor any tincture in either, nor hissing noise, which happeth 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 unty this knot, whereunto I shall leave the Reader. Lastly, whosoever shall con-*

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

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

Whereon the Commentator,
Vitreo viridi Nymphis apto.

Which is in all Glaſs, and therefore may be call'd the Soap thereof; but alſo to tinge it, which it doth with a Red, Black, Purple or Murray colour; nay 'tis the moſt univerſal ingredient into all colours, as this preſent work demonſtrateth. Concerning it Cæſalp. l. 2. c. 55. *more largely and very well in theſe words.* Hoc genus Magnetis hodiè vulgo Manganeſe 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 verò amplius, colore purpureo. Affertur ex Germania, foditur quoque in Italia in montibus Viterbii & alibi. Meminit & Plin. speudomagnetis. 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 liquour of Glass as the Load-stone doth Iron. 'Tis a Blackstone like the Load-stone, the Glass-men use it. For if a little thereof be mixed therewith it purgeth it from improper colours, and makes it clearer, but if too much it colours it Purple. 'Tis brought from* Germanie, *'tis also dug in* Italy *in the mountains of* Viterbium *and 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* Syderea (*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* Cohæsion *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

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 metalls, 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. & Cæſalp. *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 invistated with the tenacious substance of Glass? and what strange choice can there be supposed in the* Manganese, *that it should call out the Greener part onely of the metall to be carried away with it into the air, and in insensible vapors too? The reason seems to me to be onely a change in the figure and minutest parts of the metall, for the fire making the* Manganese *run, mixeth it with the smallest* atoms *of the metall throughout, which by boyling, and various agitation and revolution of them frames those* atomical figures *which are apt to reflect most of the light which falls upon it, and is the same we call White. Multitude of instances might be given to illustrate this doctrine of the production of colours by mere transmutation of parts, but we shall content 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* Verdegreas (*in which 'twill eaſily diſſolve*) *into as full a Green as the natural colour of Glaſs, and ſhake either of theſe very well together, with the yolks of Eggs, and they all make a very clear and white colour. Or elſe take a ſtrong* lixivium *of the* Soap-boilers, *and mix it by agitation with the Greeniſh oyl of Elder, and you ſhall therewith make that medicine Phyſicians call* Lac. Virginis, *you may do the ſame with any other oyl, and the ſaid Lee. Here you have the colour of a Yellowiſh Red-lee deſtroy the green of the Oyl. Again Oyl of* Tartar *poured on the green water made with the ſolution of the* Pyrites *in rain water, gives a white colour, nay the ſaid Oyl poured on Green or Blew* Copperas *diſſolved in common water, effects the like, though the colour will not be altogether ſo White as in the former, unleſs you add a great quantity of oyl of* Tartar. *Which inſtances ſufficiently refute the way of exhalation, and manifeſtly convince that this purging of Glaſs, is wrought onely by a various texture, and poſition of the parts of the metall, made by this new acceſſion of* Manganeſe. *Nay, what other reaſon can be aſſigned, but this change, why Salt and Sand both moſt white, ſhould pro-*

duce

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

That Manganese consists of much Iron seems beyond contradiction, which may be evinced by these experiments. I poured Aqua-fortis upon some powder of it, and in a narrow mouth'd Glass, the water rose up in great bubles, and immediately boiled over the Glass, and in a Glass, with a wider mouth it rose less, and a strong, and most piercing fume there from, offended much my Nose-thrils. And Spirit of Vitriol poured on it 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 Manganese *makes the metall rise much, and boil as all Iron or Steel alone, or* Crocus Martis, *or any other preparation, or composition thereof, which quality is also common to* Copper, Brass *and* Lead. *Observe here, that whereſoever any of these are put into the pot our Author commands that it be done leasurely 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 wherever 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* Moran. *Wherever the Lead-Ore-Men find it, they certainly conclude that Lead-Ore lies under it. They call it Pottern-Ore, because the Potters spend such great quantities of it, this being the onely materiall wherewith they colour their ware Black, as they do Blew with* Zaffer. *They*

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

Chap. 14, 15. FErretto *of* Spain, *commonly call'd* æs ustum, *or burnt Brass, and 'tis made* Latin, *by* Cœsalp. 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 Ferrettum, sed nigrum est, inficit ingredine, ideò 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* Ferrettum, *but 'tis Black and colours Black, therefore they use to colour therewith their hairs Black. But if it be calcin'd to a mediocrity it appears Red, & 'tis*

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 discourse of* Cæsalp. *that some Countries afforded better* Ferretto *than others, as* Castile *Soap, and* Venice *Glasses are the best, but we find no such difference in the several climates, that we need fetch any thereof from* Spain.

The two most eminent and singular colours, both in themselves, and in relation to animals, and to this Art of Glass, are Blew and Green; in themselves, as partaking much of light, as is seen in the Triangular-Glasses, and they are also most delightful and agreeable to the sight, and eyes of animals as neither widening nor contracting the Pupil too much, both which are dolorous and offensive; and in the Art of Glass, in Pasts, 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 co-

lour of Blew the Ground, and Yellow super-induced, 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 undiscernable 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 Verditers, who sometimes with the same materials, and quantities of them for their Aqua-fortis, and with the same Copper-Plates, and Whiting make a very fair Blew Verditer, otherwhiles a fairer or more dirty-green. Whereof they can assign no reason, nor can they hit on a certain rule to make constantly their Verditer of a fair Blew, to their great disprofit, the Blew being of manifold greater value than the Green. Now although the genuine and natural colour of Brass and Copper, is the true Sea green, mixed of both colours, yet the former inclines more to a Blew than the latter, and the dissolvents have a great share in this business. For Verdigreas made of Copper-plates buried in the earth with Grapes, makes a Green, but Copperas made with Copper, and the 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* Verdigreas *turns it to a Green, being exalted by the acidity of the Grapes. And this seems also to be the cause, why* French-wine-grapes, *which have more acidity in them than* Spanish-wine-grapes *have (though the climate of* Spain *be more suitable than that of* France) *are fittest to work this effect. The force also of* Vitriolate *juyces may be seen in our* English Copperas, *and* Vitriol *of* Mars, *made of* Spirit *of* Vitriol *and* Steel, *both which change the natural Yellowish colour of Iron into a Green, and* Lapis Armenus *a Blew stone ground with Vineger, or the tincture thereof drawn. The effect of* Calaminaris *in drinking in the acidity of the* Vitriol *do the same, an ingredient into* Aqua-fortis *is clearly manifested, by a pretty and lucid experiment,*

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 wholy præcipitate the said silver, but left ten pound thereof in thirty remaining unpræcipitated 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 præcipitation, for the new advenient metall coming into the place of

the

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 falsly call'd*) *the shells of fishes or* Lapis Lyncis, *and whiting 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,

then with Vitriol, c. 15. *Thirdly, a simple calcination of* Brass *by fire*, c. 20. *of scales of* Brass, c. 24. *Fourthly, scales thrice calcin'd*, c. 25, 28. *Fifthly, the making of* Vitriol *of* Venus, c. 31, 132, 133. *All which are so well known to the meanest* Chymists *I shall need to say little of them, especially having given so large an account, how the two prime colours, Blew, and Green are thence educed. But above all these preparations, that of* Vitriol *of* Copper *carries the preheminence, and next to that being prepared the same way with it, the calcination with* Sulphur, *and especially with* Sulphur vivum *in a clear and strong fire makes a better colour than any of the other calcinations mentioned by our Author. For though Originally* Brimstone *and* Copperas *are made of the same* Marcasite, *and produce Spirits undistinguishable each from other, yet* Sulphur *sooner and better penetrateth into the body of the metall, being more vehemently driven in by the most acute and sharp points of the flame, and so consequently divide more 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

as 'tis well known Copperas *with gals or any other astringent* vegetable *make Ink, and the Black for dyers. But if you list to try* Vitriol, *you must not use* English Copperas *made with Iron, but that which is made with* Copper, *Because experience teacheth the Refiners that* Aqua-fortis, *made with it will carry 'its foulness through all their mediate solutions even to the* Verditer *'its self, which 'twill make infallibly of a dirty Green colour. Wherefore they make their* Aqua-fortis *of* Dantzick Copperas *onely.*

Whosoever then would extract a good colour with Aqua-fortis (*which 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 tr Glaſs, for upon the diſſolution thereof with* Aqua-fortis *it ſhooteth into Green Cryſtalls, 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* Verdigreas *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 emporeti eam, *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*

sequently the best reverberation. The time of Calcination is about five hours, in which space they often rake it about with a great Iron rake, It requireth good judgement to calcine it well: for when 'tis not sufficiently calcin'd 'twill not mix with the Copper, *and when too much, 'twill make it too brittle, and in both cases gives not the true tincture to* Copper. *The sign of it's just calcination is, when 'tis in a white and very fine powder. Almost half of the* Calamie (*as the workmen call it*) *is wasted and flies away in flour, which sticks to the mouth of the Furnace of divers colours of little use with them, though I could easily prove these flours to be the true pompholix of the ancients, and to be used in the ointment, that hath it's denomination thence. 'Tis an excellent dryer, and applyed to Gleeting Nerves, and Tendons, without pain, it soon exiccateth them. This powder I communicated to the eternal glory of our nation, and* Anatomy, *& an excellent Chirurgian, and never to be by me forgotten the incomparable Dr.* Harvey, *a man most curious in all natural things, who confessed he thought this to be the said* Pompholix, *and with most happy success frequently used it. Now when the Calamie is well 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* Calamie *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* Calamie, *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 readiness, because after three days casting they become weary (as they call it) and must be new coated with coal and tallow. 'Tis to be observed that the mixture of the Calamie *and Coal, must be always put under the* Copper-plates, *for then the* Calamie *being raised by the 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 flyes 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, 17, 18, 19. *Deliver several wayes of making* 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 brushed off in a considerable quantity. The second way is a calcination or reverberation with Brimstone, Salt, Urine, Vineger. Thirdly, by solution in* Aqua-fortis, Aqua-regis, *Spirit of Salt and* Nitre, *and then by exhaling the waters you shall have a very Red powder. The solution of Iron in Spirit of* Vitriol, *or of* Sulphur *make the* Vitriolum Martis, *not much differing from our* English Copperas *in goodness but onely in strength, either as to dying, or Medicines, which being calcin'd makes a* Colcothar, *not unlike that of common* Vitriol, *which though it may serve Painters for a deceitful colour, yet 'twill not serve the Glass-furnaces, for all* Colcothar *contains in it much terristriety which would make the Glass foul and obscure, this seems to be the reason, why our Author useth not* Vitriol *here, as he doth before with* Copper.

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* Antionomy *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. PORT. 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*

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

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

Observations

Obſervations on the Author.

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

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

ent in them all. Most make it of Vitriol, *some of* English Copperas *which serves for common uses, and for* Dow-dies (*though made of* Dantzick Copperas *would be better for that use*) *for this the refiners use finding a dirtiness from our* English, *some add alum instead of* Vitriol, *but that yields at best but a weak phlegm, Others have made essays with* Sal *gemm, but they found that this Salt affords no Spirit, but sticking to the neck of the retort, hinders the passage of the Spirits and breaks the vessels. When the red fumes are past all the Spirits of* Nitre *are raised, and then the fire is to be extinguished, for after followeth onely the Spirit of* Vitriol, *which hindereth the operation of the Spirit of* Nitre *towards the solution of metals. I have often seen singular good parting water drawn by the refiners twice in* 24 *hours, in which time, with their fire, not much of the Spirit of* Vitriol *could arise, which requireth commonly three days with the strongest fire can be made for the two last days to draw off both the Spirit, and ponderous oyl from it, though the volatility of the* Nitre *in* Aqua-fortis *may help to raise them. One thing our Author omitteth though very necessary to be done before the* Aqua-fortis *be used, practised constantly by the refiners*

refiners, else their waters will be foul, the manner is thus, as you have it in Beg. Tyrocin. Chym. c. 3. *Take of the distil'd water and put into it a peny weight of refined silver, and dissolve it upon coals, then pour this silver water into three parts more of the unfined* Aqua-fortis *which will become of a milky colour, then they let it settle, and decant off the clear, this setling the refiners call the fixes, and cast it into a tub of water of 20 gallons, all which it will in a moment turn to a milk colour. I know a refiner who destilleth his* Aqua-fortis *out of an Iron pot, which he finds to make a stronger water, besides the great charge in pots and fire saved, you may see the way in the commentator on* Beguin.

Chap. 40. *You need not charge your* Aqua-Regis *with so much* Sal Armoniac *as it will dissolve, one ounce and a half to a pint is sufficient. I wonder at* Beguins *way of making this water, who distills the* Salt-peter *and* Sal Armoniac *together, but experience hath taught me that half the quantity of* Aqua-Regis, *wherein* Sal Armoniac *hath been dissolved, will do as much as neer double the quantity of that wherein it hath been distill'd,* Aqua-Regis *onely blacks silver, but*

'twill slowly dissolve very thin plates of Copper *and* Tin, *as* Aqua-fortis *will corrode* Leaf-Gold. *But if you draw off the water when it hath dissolved Gold, then 'twill fall upon Silver or other metalls.*

Chap. 42. *THe 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, Soot, Sal Armoniac, Mercury. *Fourthly, that some of them are of an unctuous nature, as* Lead, Soot, Tartar *and* Smalts, *which may hinder the union of the materials one with another, which appears by this, that they do part one from another, and therefore the metall being taken when it begins to grow cold, will then shew some waves, and divers colours very fair,* chap. 42. *A great deal of Art there is in working the metall at a due heat, and in the manner also, and in this latter much of Art lyeth as it doth also in marbling Paper.*

Porta *teacheth how to colour Glass with various colours, this he found out by chance, when he was making other tryals. Calcined* Tin *takes*

away

away the perspicuous colour of Glass and variously colours it, for when 'tis sprinkled by turns on Glasses polished with the wheel, and exposed to a kindled fire, it colours them variously and renders them darker, for one part becomes stone, the other is variously coloured that 'twill seem an Opal. *But you must often take them out of the fire, and fit them till you have your wish.*

Here and in many other places our Author tells you that Glass may be wrought into any shape. I shall for the Readers delight set down the most curious I have met with. Card. 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 fit colours,*

lours, and covered in some places with Gold.

Chap. 48. PORT. l. 6. c. 5. *makes this Amethist colour with a* Drachm *of* Manganese *to each pound of Metall.*

Chap. 49. PORTA *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. *DEep Reed in the original,* rosso in corpo, *whereof thus,* Imper. l. 4. c. 1. haver corpo dicono quelli colori che coprono e sono senza transparenza, 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. GLass 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 transmut. met. l. 7. c. 20. *saith, that the melters, and tryers of metals daily change* Lead *into Glass, and that this Glass is* Black, Red, Yellow, *or otherwise coloured, as the calcined* Lead *is handled, or as* Lead *is calcin'd into* Lytharge, Cerus *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* Cerus *before, and the like you shall find in* Minium, *the higheſt calcination used thereof. Now the cause why it breaks out the bottom of the pots seems to be, that receiving there a new calcination, and closing with it's unctuosity, and body the pores of the pots, it hinders the passages of the fire into the metall, which impeded, converts all it's force upon the clay, whereof the pots are made, and*

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

Our Author mentions not a Jacinth *from Glass of* Lead, *nor Glass of* Tin, *nor of* Copper. Bapt. Port. *supplies you with the first,* l. 6. c. 7. *in these words,* To make a very Jacinth, *and not much differing from the true one. Put* Lead *in earthen pots that are very hard in a Glass Furnace, and there let it stand some days, and thus your* Lead *is turned into Glass, and imitates the colour of the* Jacinth. *and of the second* lb. c. 9. *Melt a pound of* Tin *in an earthen pot that will bear the fire, let it stand in the Glass furnace three or four days, then take out it, and break the vessel, and on the surface you shall find a Glass of a muddy Saffron colour, and if it stand longer in the fire 'twill become more perfect. Neither know we any more perfect in this kind of many we have tryed. But you must put it into the pot well powdered, wherein you must use not onely Mortars and Mills, but the* Porphyrie-stone, *if you would have it lighter, dilute it by adding Glass. Another way reserved for his friends is this, let there be nine parts of calcined* Tin, *seven of* Lead, *two of* Cinnaber, *of* Ferretto *of* Spain, *and of* Tartar *one part and a half, of* Lap. Hæmatitis *or* Blood-stone, *one part,* Red-ochre *a quarter,*

quarter, do as thou knowest. His Glass from Copper, l. 6. c. 7. *is this, Dissolve Silver in a strong* Aqua-fortis, *then cast it into the water,* Copper-plates, *to which the Silver will stick, which gather and dry, then set it in the Glass furnace, and 'twill be turn'd into an* Emerald *in few days. I commit to you the tryal of other metals, 'tis enough for me to have searched out and shewed the way.*

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

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

Chap. 74. THis *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 exhations 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* Amethists *than in other gems, though many other Jewels afford the like, some having in some part a colour, and some others wholy without any, or else the several parts tinged with diversity of colours.*

Chap. 75. THe knowledge to imitate Emeralds, &c. *There's nothing of value, but some way hath been found to Sophisticate it. And since the counterfeiting of Jewels with exactness, would bring more profit to the inventer, 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* Mosaick *work was made in this manner as* Hermol. Barbarus, describes *it.* Musivum opus quod vulgò Museacum vocant, tessulatum lapillis variorum colorum, ex queis arte compositis & coagmentatis omne genus imaginum redditur. Mosaick *work they call that which was checquer'd with stones of divers colours, with which compos'd 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 expresly imitate in various colours, the effigies of Fishes and other things. *But the use of coloured Glass succeeded the use of Marbles, and other stones.* Libav. *in his* Syntagm. *saith, the* Saracenical *Authors call them* terra Saracenica, *but he confounds these* Enamels *and* Pasts *one with the other. 'Tis true these two are very neer of kin, but are distinguishable by this, that* Pasts

are made of Crystall, *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. Pasts *were found out by chance by those who reducing calcin'd bodies with a strong fire, converted them into Glass, and adds out of* Isaac Hollandus, *that metalls vitrified and reduc'd yield better and more noble Metalls than those which were first vitrified, to wit, Gold a tincture, silver gold, and copper silver,* &c. *he saith, noble Glasses might be made of Metalls, could* Chrysibles *be made strong enough to hold them; what he saith in many words, concerning the preparation of* Crystall *casting into molds and colours, contains nothing but what's vulgar.*

Chap. 76. HArtm. in praxi Chym. *hath this peculiar way of preparing* Crystall *for making of Jewels. Dissolve, saith he, in water two ounces of purified salt of* Tartar, *which moisten with* Beechen-ashes, *make thereof balls as big as apples; Dry and burn them in a potters furnace in a covered*

ed pot, for so the balls will somewhat melt, and stick one to another, let them then be finely pounded & a Lee made thereof, which congele to a Salt. And in this Lee let the Crystalls *be so often, and so long extinguished, till you can rub them to powder, betwixt your fingers. This being done, let some of the remaining salt be so often purified by solution, coagulation, and calcination, till no feces at all appear in the solution. Take then of purified salt of* 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 Pasts *differs nothing from that of Glass, but that* Pasts *are made of* Crystall *prepared, as the other of* Crystall *metall, the colours in both are the same. And therefore* Porta *calls his Glass tinged with colours, by the names of* Amethist, Ruby, &c.

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

Chap. 77. BOeth. de Boodt, *an excellent writer upon stones, writes thus of adulterating the* Emerald, *This may be done several ways. The best is with* Crystall, Glass *and* Flints *calcin'd, and melted, if a little quantity of* Minium *be added to them. So I have made good ones. He subjoyns, the making of them with burnt* Brass, *half the weight of* Crocus Martis, *boil them six hours, and let the pot cool of it's self. If they be well made they will be wholy like those that come from* America. Garcias ab Horto *affirms them to be made fair coloured and very large in* Balaguate *and* Bisnager *of larger fragments of glass pots,* Dalechamp, *thinks some green* Jasper *is to be added to them.* Birelli, l. 8. c. 9, 10, &c. *gives you the same composition with our Author, where you have many more. Another of* Minium *and* Copper-scales, c. 5. *like our Authors,* c. 78. Hartm *gives several ways, the first obscure, and unintelligible with* Anima Lunæ, *and* Solis, *and* Crystall, *with a little* Sal Armoniac *fixt with lime; a second with*

with Minium *four ounces,* Crystall *prepared one ounce, gold two drachms; the third with* Brass *calcin'd and powdered fine, mixt with a double weight of Sand for Glass, and standing four days in a very strong fire, and half a day more in a stronger fire. A fourth with his prepared* Crystall *mixt with a little* Copper, *fill herewith a pot half full, set them at a gentle fire four or five hours, then run them in a strong fire, then take away the fire, and break the pot, you shall find the stuff covered with the spume of Lead, which break, and a fair* Emerald *will appear, which he caused to be broke into pieces, and to be cut to his liking. This succeeds not always well, for a serene air is necessary. Therefore he prepared it in a forefold quantity, in four several pots, and so with one labour had four distinct colours one higher than another. For the first he took of* Copper *a scruple, for the second two scruples, for the third one drachm, for the fourth a drachm and a half, and nothing else, for otherwise they will not be transparent. The same is to be done with* Jacinth *and* Topaz, *with* Crocus Martis, *and with the* Saphyre *with* Zaffer.

But in this composition Mars *is wanting to give life and lustre to his* Venus. Card.

de var. l. x. c. 52. *makes this colour of stones taken out of the river calcin'd to whiteness, and then mixed and melted with an equal quantity of* Minium *in a* Chrysible, *and this must be twice done to effect this colour, but this way is wholy 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. BApt. Porta *thus adulterates the* Topas. *He mixeth to every pound of Metall a quarter of an ounce of* Crocus Martis, *and a little* Minium, *and that*

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* Cryſtall, *and four times as much of* Calcined Tin, *ſet them a day in a fire not too ſtrong, but kept in the ſame degree, for the ſaid powder eaſily melts.* Birelli *proceeds this laſt way, onely changeth* Cinnaber *into* Minium, *and in the very ſame words, ſo that* Boodt *had this from him, as the former from* Porta. Hartm. *and* Libav. *with three ounces of* Ceruſs, *and* Cryſtall *prepared half an ounce. The Author of* quadrig. Chym. *makes Salt of* Tin *to be the* Topaz.

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

Chap.

Chap. 85. A Saphyre. Glauber *makes this colour with Silver* Marcasite *dissolved in* Aqua-regis, *and precipitated with his liquour 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 liquour 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. TAke Cerus. *Our Author delivers two ways of making* Saccharum Saturni, *the one here of* Cerus, *the other of* Lytharge, Chap. 123. *onely in this he calcines the* Saccharum, *and out of it calcin'd remakes a new* Saccharum. *The* Chymists *commonly take* Minium, *some onely calcin'd Lead, all returns to the same purpose, but 'tis observed that* Minium *yields a greater quantity of Salt, and good reason, for that hath had more calcination than any of the other. All make use of distil'd vineger alone, but* Beguin *he substitutes in it's place* Phlegm *of distil'd vineger, but the commentator well passeth a deleatur upon it. Two things I shall here set down, the one that 'tis much better and less chargeable by far, to pour distil'd Vineger on new* Minium *at each time, and not 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. *This 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 Esmailler *which comes* à maille macula *a spot as* Minsheu, *for so 'tis laid on. In* Latin Encaustον (*that is burnt in, a* καύω *to burn*) *for so the* Lexicographers *render* Eucaustον Enamel, Encaustice, *the art of* Enamelling, Encaustes *an* Enameler. *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* Salmas. *in* Solin. *who truly concludes his discourse, that all this Art is lost.* Porta *makes a* Latin *word, of the* Italian Smalto, *calling them* Smalti *and* Libav. Smalta.

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

Chap. 95. A Turcois, *by* Porta *with* Zaffar *alone.*

Chap.

Chap. 97. For *a Green* Porta *takes* æs ustum *which the common people (saith he) call* raminella, *and by our Author* ramini, Chap. 24. *for a deeper colour, and for a lighter, the* Scales *which fall from the hammers, when the Brass is hammer'd Red hot.*

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

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

Chap. 108. A Lee *of* Barillia *and* Lime. *Much care is to be had of the* Menstruum, *this of* Lime *and* Barillia *are the best, though pot ashes with* Alum, *do very well also. I know an Ingenuous 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. WHatſoever 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 chaw 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.* Campegiana *and* Sylveſter, *which are two ſorts of grains or ſmall berries brought from the* Weſt-Indies, *they make a grain colour, though not ſo good as* Cochineel, *yet they are uſed in ſtead thereof.* Red-wood, Symach, Braſiletto,

siletto, *or* Sweet-wood, Turmerick, Saffower, *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 leafed of* America; *some plants have a coloured juyce, as the Spurges, Sow-thistles, Dandelion, Tragopogon, Periplocas, Rampions, Lettices*, &c. *most whereof dryed 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* Tutsan *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 Dwale 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 steept in water it communicates it's colour thereunto, scarcely to wine, but in no wise to Spirit of Wine, so far he. 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, balaustia *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* Pharmacopæas, *and* Chymists *teach this way of our Author.*

But

But the extraction of the Spirit of the wine thus tinctured 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. 111. THis *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. 112. TO reſtore the decai'd colour of Turſcoiſes. *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 bodys 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 therein of* Tartar *and* Crystalline Arsnick *of each two pound, when you see them smoak, put in fifty pound of old worn-brass, melt them six or seven times, that they may be purified and refined, then presently add twenty five pound of* English Tin, *and melt them all together. Take a little hereof with an Iron out of the pot, and try whether it be britle or hard, if britle add* Brass, *if hard,* Tin, *or else boil it till some of the* Tin *fly away, when it hath the desired temper, cast upon it two ounces of* Borax, *and let it alone till the fume be gone, Then cast it into a mold and let it cool, when cold rub it with a* Pumice, *then with* Emerie, *when*

when you see the superficies smooth and polished, rub it with Tripoly, *and lastly with fit* 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*

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 whil'ſt it ſticks to the wood with* Putty *(ſo the* Gold-ſmiths *call* Tin *calcin'd) mixed with* Tripoly. *And for the laſt poliſhing with* Tartar, Soot *and* aſhes *of* Willows *or* Juniper, *which will make it ſhine beſt of all.* Emery *is prepared by powdering ſercing and wetting.*

Cardan. l. 2. de variet. c. 57. *Glaſſes call'd* Steel-Glaſſes *are made of three parts of* Braſs, *of one part of* Tin *and* Silver, *and an* 18th *part of* Antimony. *Moſt leave out the ſilver for the charge, others add onely a* 24th *part, as* Aldrovand. l. 1. c. 4. Muſæi *Metall relates. Some make it of a pound of* Tin, *a third of* Braſs *melted, and then add an ounce of* Tartar, *and half an ounce of white* 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 dryed* Tartar *one ounce, white* Arsnick *half an ounce, let them stand on the fire as long as they smoak, and in the casting, and polishing proceeds as the other Authors.*

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

(*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. *THis way of colouring Glaſs Balls on the inſide, is now changed into another of* Paſting Pictures *on the outſide of* Balls, *they are very pleaſant, commonly hung up in houſes.*

Geſſo. *Whereof thus* Cæſalp. 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* Alablaſter, *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. ULtramarine, *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. *cals fixed, others will lose their colour in the fire) then the way to calcine it, to make vessels, Lees, strong and weaker Plaisters, 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. LAke *from* Cochineel. *No doubt this word comes from the Gum call'd* Lacca, *the colour and tincture whereof have both the same colour, with this of the* Painters. Math. in l. 1. Dioſc. c. 23. *asserts there are many kinds of Artificial Lake which are made of the Sediment of several tinctures. One is made of the Berry* (*head*) *of Burnet which they commonly call* Cremese *and* Cremesino (Crimson) *another of* Chermes Berries, *a third of true* Gum-lacc, *and lastly a fourth of* Brasil, *the worst of all, but he sheweth not the way of making either of them.*

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

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

I find in several writers receits for making Lakes, differing onely, either in the materials from which, or in respect of the Menstruum *wherewith they are extracted. Some use* Chermes-berries *or* Grains (*a syrup 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* VVhite-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.*

Her-

Hernandez *in his* Hist. l. 3. chap. 45. *thus of making* Lake *in the* Indies. *Of* Nocheztli, *that is* Cochineel, *sometimes a* Purple, *sometimes a* Scarlet *colour is made, according to the various ways of preparing it.*

The most exquisite is made by beating it with the water of the decoction of the tree call'd Totzuatl, *adding* Alum, *and the setling 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 aad drying the Lake made. As to the laſt I ſhall add this, that Chalk-ſtones *ſooner dry by imbibing the moiſture than Bricks do, as the conſtant practice of Painters in making Paſtils, and of the Refiners in drying their* Verditers *confirmeth. Before the Lake be fully dry, they form it into Balls, or cut it with a Wooden Knife (not with an Iron one) into what ſhapes and figures they pleaſe, or they may do as Painters for their Paſtils, caſt them in furrows made in the ſtone.*

Chap. 117. SAline *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.

Chap. 118. Birelli *makes his Lake from* Brasil *thus, He first extracts a tincture from* Flox, *and then takes a pound of* Brasil *cut (ground is better) and boils the* Lee *to the consumption of a fingers thickness, then 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 halfs at a time, stir them speedily, then with Iron ladles cast them iuto 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* Role, *which you may use to* Enamel *upon Gold.*

Chap.

Chap. 126. *To 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. TO 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.* Begum, c. 17. *ſets down this way, Powder calcin'd* Copper, *or it's ſcales very fine, which digeſt 24 hours in diſtil'd vineger. Pour out the Tinctured Vineger by inclination, and pour on more till 'twill be no more coloured.* Filtre *the decanted liquours, Evaporate, or diſtil off a third part, ſet the remainder in a cold place, and you ſhall have Green and obſcure* Vitriolum Veneris.

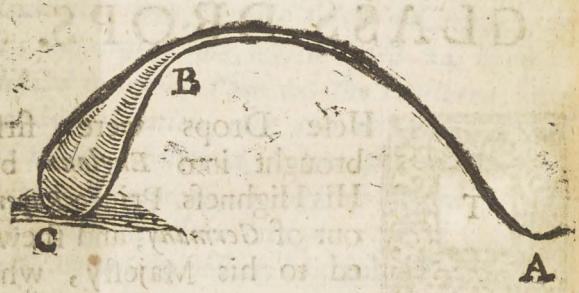
FINIS.

AN ACCOUNT OF THE GLASS DROPS.

THese Drops were first brought into *England* by His Highness Prince *Rupert* out of *Germany*, and shewed to his Majesty, who communicated them to His Society at *Gresham* College. A Committee was appointed forthwith by the Society, who gave this following Account of them, as 'tis Registred 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

experiments to be made in any kinde whatſoever, as being done with exceeding exactneſs.

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



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

They are made of *Green-glaſs* well refined; till the Metall (as they call it) be well refined, they 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 thred or string it hangs by, as has been in the water, will upon breaking fall into small parts, but not the Body, although it have as large cavities in it, as those that fly in pieces.

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

When a Glass drop falls into the water, it makes a little hissing noise, the body of it continues red a pretty while, and and there proceed from it many eruptions like sparkles, that crack, and make it leap up and move, and many bubbles do arise from it in the water, every where about it, till it cool: but if the water be ten or twelve Inches deep, these bubles 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

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

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

Almoſt all thoſe that are made in water have a little 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 vineger.

In oyl of *Turpentine* one of them broke, as in the ſpirit of wine, but the ſecond ſet it on fire, ſo as it could no more be 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, assoon as the drop was let fall into it, observed that at the first falling in, and for some time after, whilst the red heat lasted, red sparks were shot forth from the drops into the water, and that at the instant of the eruption of those particles, and of the bubbles which manifestly break out of it into the water, it not only cracks and sometimes with considerable noise, but the body moves and leaps, as well of those that remain whole in the water, as those that break.

A blow with a small hammer, or other hard tool will not break one of the Glass Drops made in water, if it be touched no where but on the body.

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

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

Some 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.

FINIS.

An Appendix.

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

TWo Bars *to lift their pots into the Furnaces, each 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

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

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

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

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

The Pipes *are the hollow Irons to blow the Glass.*

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

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

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

Shears *are the Instruments to form and fashion the Glass.*

Sciffers *cut the Glass, and even it.*

Cranny

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, protuberances,* &c. *according as they are cut in them.*

FINIS.

Errata Corrigenda.

EPiſt. 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.