

## Isaac Newton. Laboratory Notebook from 1678 to 1696.

### Section 81-87: Of Salts, & Sulphureous bodys, & Mercury & Mettalls.

To make Regulus of  $\delta$ ,  $\sigma$ ,  $\eta$ , our  $\psi$  etc. Take of  $\delta$  12  $\bar{3}$  of  $\sigma$  4  $\frac{1}{2}$  or 5  $\frac{1}{4}$  or  $\psi$  6 or 6  $\frac{1}{4}$ , or of  $\eta$  8  $\frac{1}{2}$  or proportionably more to the  $\delta$  if it will beare it. When they are melted pour them of & you will have a Regulus. You may when they are molten throw 2 or 3  $\bar{3}$  of  $\circ$  on them which having done working pour them of. If the scoria of  $\eta$  bee full of small even rays there is two little  $\eta$  in proportion. If any regulus swell much in the midst of the upper surface it argues two much  $\delta$  if it bee flat it argues two little. The better your proportions are the brighter & britler will the Regulus bee & the darker the scoria & the easier will they part: And also the more perfect the starr, unlesse the salts on the top worke & bubble in the cooling to disturbe the said superficies. The work succedds best in least quantities. If there bee stuff like pitch long in cooling tis noe good signe & often argues too much Antimony. Twelve ounces of  $\delta$  gives 4  $\frac{1}{3}$  of Regulus of  $\sigma$  3  $\frac{1}{3}$  of Regulus of  $\psi$  or  $\eta$  when refined. To refine it, so soone as it is molten throw in  $\frac{1}{4}$  or  $\frac{1}{5}$  part as much salt peeter as there is regulus in weight; then blow to give a good heate till the mettall & salt boyle well together, & also till they have done boyling & working, then poure them of. This you may repeate till the salt come of. white, which will bee at the second or 3<sup>d</sup> refining. Mix noe charcoale with the peeter least the peeters force be otherwise spent then upon the mettall. Tin may bee 5  $\frac{1}{3}$  to 12 of  $\delta$  or 4 to 9. If the quantity bee but small as 2  $\bar{3}$  of tin then take 4  $\frac{1}{4}$  of  $\delta$  but if bigger take 4 to 9. Note that in Tin & Lead if the scoria bee full of very small striae like haire or rays tending from the center of the metal it argues too much  $\delta$ . If it bee branched with grosser graines (which in tin especially will appeare continuous to the centrall metal) it argues two little  $\delta$ . Tis best when the scoria is haire-grained inwards towards the center of the metall but not quite to the outside, unlesse it happen that the scoria look black. These rules in generall should bee observed. 1<sup>st</sup> that the fire bee quick. 2<sup>dly</sup> that the crucible bee through heated before any thing bee put in: 3<sup>dly</sup> that metalls bee put in successivly according to their degree of fusibility  $\sigma$ .  $\psi$ .  $\delta$ . 2.  $\eta$ . 4<sup>thly</sup> That they stand some time after fusion before they bee poured of accordingly to the quantity of regulus they yield,  $\sigma$ ,  $\psi$  [or] 2. [ or ]  $\eta$ . 5<sup>thly</sup> That at the first time noe salt bee thrown on, unlesse upon  $\sigma$  to keep it from hardening on the top & then let it bee poured of when the fury of the salt is over before it have quite done working. 6 That if you would have the saltpetre flow without two great a heat, you may quicken it by throwing in a little more saltpeter mixed with  $\frac{1}{8}$  or  $\frac{1}{16}$  of charcoal finely powdered.

Also these signes may bee observed in generall. That if the scoria & Regulus part not well there is two much metall; that if they doe part well & yet yeild not a dew quantity of Regulus there is too little metall (unlesse the fire hath not been quick enough or the regulus not had time to settle) That if the regulus bee tough it argues too much metall unlesse in tin which is therby made the brittler. That possibly the proportions of the metalls may alter in the refining Thus  $\psi$  of  $\sigma$  being more volatile then that of  $\delta$ ; if there bee two much  $\sigma$  at first, it may in 3 or 4 times refining come to a good proportion. That the degrees of fire may cause some variations in the proportions. Thus with a good quick & smart fire 4 of  $\sigma$  to 9 of  $\delta$  gave a most black & filthy scoria & the Regulus after a purgation or two starred very well. But in a lesse heat a greater proportion of  $\delta$  gave the blackest scoria.

If the Regulus be powdered & mixed with 1/2 or 1/3 of Niter & so thrown gradually into a crucible, the better half of the regulus will be lost in the Salts, but if a little charcoal be mixed with the salt (suppose an 1/8 or 1/12 part<)> to make the salt deflagrate, it will not consume so much of the metall.

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2 1 + Regulus 2 1, Or Regulus 2 1 + ♁ 1/2, or Regulus ♁ 1 + Regulus ♀ 1 + ♁ 1 1/3 or Regulus 2 2 + ♁ 1 or Rete 3 + Regulus 2 2 + ♁ 2 or ♂ 2 + 2 5 or Rete 3 + ♁ will amalgam before the ♀ fly.

If Regulus ♁ melted be dropped upon ♀ it will amalgam but noe other Regulus.

R ♂ 9 1/4, ♀ 4 gave a substance with a pit hemisphericall & wrought like a net with hollow work as twere cut in R ♂ 8 1/2, ♀ 4 gave noe pit but a net work forme spread all over the top, yet more impressed in the middle R ♂ 2 ♀ 1 gave net worke but not so notable as the former, & so did R ♂ 5 ♀ 2 The best proportion is about 4, 8 1/2 or 9.

Salt or oyle of Tartar put into Aqua fortis gradually till it be satiated after ebullition becomes saltpeter by incorporating the acid spirit, yet without any praecipitation of earth in the action. If Sal Armoniack be put into Oyle of Tartar per deliquium, its acid salt will let go the urinous & work upon the Alcaly. And the urous thus let loos becomes very volatile so as to strike the nose with a strong scent & fly all away if it be not soon inclosed in a vessel.

So if to a solution of crude Tartar in water be put by degrees Salt of Tartar, or Tartar calcined suppose to black, the acid spirit of the Tartar will forsake the Alcalisate (or urinous) to work upon the fixt Salt of Tartar. And the Alcalisate (or urinous) salt thus let loos becomes very volatile so as to fly suddely away. And in the remaining Solution will be a salt compounded of the acid spirit of Tartar & sulphureous or volatile part of the Alcaly, which salt is volatile but not more volatile then Sal-armoniack or its flowers. But by the addition of new Salt of Tartar (perhaps after it hath been sublimed) in which the acid may work the urinous will be let loos & become exceeding volatile as before & in the action the earthy parts of the fixt salt will be praecipitated.

If Tartarum Vitriolatum (which is commonly known, & to be had in shops being a precipitate made by dropping oyle of ♂ upon salt of ♁) be put into oyle of Tartar per deliquium it makes a great effervescence, & an earthy sediment is praecipitated out of the salt of Tartar by the acting of the acid spirit of the Vitriol upon it. This precipitate some fools call Magisterium Tartari Vitriolati Sal Armoniack consists of an acid & urinous salt both which are severally volatile enough but together they fix one another yet not so much but that the whole salt will rise with a round heate, there ascending first white flowers & then gradually yellowe ones but the yellow being more sluggish will scarce ascend so high as the white & settle into a harder mass. David Vonder Becke ad Joelem Langelottum saith that volased salt of Tartar may be again fixed by addition of another volatile, & again made volatile by an easy labour.

3 1/4 ounces of evaporated salt of antimony, 4 or 5 ounces of Saturn, about 2 ounces of sal armoniac and through fermentation in heat 2 1/2 ounces will be calcined out of the Saturn and the total weight of the calx will be 3 3/4 ounces.

1 ounce of mercury sublimate, 1/2 ounce of sal armoniac, 1/2 ounce of Venus, melted together and evaporated left behind about a half ounce in the bottom, in addition to some of the solution

which was spread out on the sand through a crack in the glass. But mercury sublimate, sal armoniac, and choice, feminine, arsenical Jupiter virtually all flew away, with about 20 grains left behind. And the glass remained unbroken throughout. Therefore mercury sublimate volatilizes arsenical Jupiter.

If Urin be digested in a close glass with a moderate heate for 6 or 8 weeks its salt will thereby be so volatised as to rise before the flegm, which otherwise requires a good heat to raise it. And the virtue of this salt is hereby much exalted. For whereas upon putting spirit of salt to fresh urin the two liquors readily & quietly mix: if the same spirit be dropped upon digested urin there will presently ensue a hissing & ebullition, & the volatile & acid salts will after a while coagulate into a third substance, somewhat of the nature of Salarmoniac.

And whereas the syrup of Violets is but diluted by being dissolved in a little fresh urin, a few drops of fermented urin presently turns it into a deep green. And the same digested urin being dropped upon a solution of Sublimate made in fair water presently turned it white by precipitating the mercury.

Exquisitely deflegmed spirit of fermented humane urin & as highly rectified spirit of wine mixed in a just proportion suppose two parts of spirit of Urin to 3 parts of spirit of wine, do suddenly coagulate into a white mass like snow which Helmon calls Offa alba & thereby attempts to explain the generation of the Duelech (i.e. stone in the bladder) because urin hath in it a little potential vinous spirit easily extricable by purification which may in that manner coagulate with the salt & at the same time lay hold on the earthy sediment. If the spirits be not highly rectified they will not coagulate, but yet if distilled together their fumes will coagulate in the head of the still like a sublimed salt. Boyle of naturall Philosophy part 1 p 32

Urin if distilld before fermentation leaves in the bottom an earthy substance & commonly some gravel. And rectified spirit of Urin after long keeping lets fall a pretty copious sediment, & if kept yet much longer there will gather to the sides of the glass little grains of gravel such as are often found sticking to the insides of Urinals imployed by calculous persons.

If fresh urin be poured upon quick lime till it swim some fingers breadth above it, & then as soon as you pleas distilled, it will yeild with a very easy heat a subtile penetrant spirit without the assistance of any putrefaction. Yet this spirit though even without rectification very strong & subtile yet will not coagulate with spirit of wine like that of putrified Urin, thoug perhaps for some other purposes it may be more powerfull.

There being a strong fire required to force up the salt of unfermented urin, out of that part which after the abstraction of 8 or 9 parts of flegm remains of the consistency of honey & then requires a strong heat to force up the salt, the volatile salt may be obtained better & more pure with a scarce credibly small heat, by tempering the urinous abstract with a convenient quantity of good wood ashes, whereby the volatile part of the salt is so freed from the grosser substance that it will very easily ascend fine & white to the top of very tall glasses.

The spirit of Sal Armoniac may be drawn much after the same ways with spirit of Urin For if two parts of this salt be mixed with 3 or 4 parts of quick lime whose virtue hath not been

impaired by being exposed to the air. This distilled in a strong fire affords (together with some dry sublimate in the neck of the retort & a little volatile salt in the receiver) a very strong & yellowish spirit so exceeding penetrant & stinking that it is not easy to hold ones nose to the open mouth of the vial wherin it is kept, without danger of being struck down or for a while disabled to take breath. But this so exceeding vigorous liquor was inconsiderable as to its quality. Wherefore it may be better to let the lime lie open protected from all moisture but that of the aire for severall days till it become somewhat britler then before for then being mingled with the salt & distilled with a fire graduated if you please till the matters flow by heaping up coales on the upper part of the Retort, you will obtain a copious & pretty strong Spirit in form of a liquor which yet if kept long will coagulate (at least in part) into the form of a chrystalised salt swimming upon the liquor yet retaining a very strong subtility. Which seems to argue it to be onely the resolved salt of soot & urin a little subtilised by the fire & freed from the sea salt; though the great energy of this spirit may imply that something comes over with it from the lime. If you have not the convenience of drawing it with so great a heat, then dissolve the \* in as little water as is sufficient & fill the Cucurbit up to the 5th or 6th part of it with strong quick lime poudered, & water it well by degrees with the solution & immediately clap on an Alembick & close well the joynts & by the gentle heat of a bath or lamp you may obtain a liquor that smels like spirit of Urin & seems to be much of the same nature. If you rectify it once or twice gently it grows exceeding fugitive & penetrant & perhaps is not much inferior to either of the former spirits.

If you would have the spirit of \* in a dry form mingle exquisitely a quantity of \* with about thrice its weight of about strong wood ashes. For the spirit thus drawn out of a retort in sand will quickly in the receiver coagulate into a salt, extremely subtile & volatile that it seems much of the same nature with that of urin. But I know not whither this coagulation will always succeed.

The spirit of \* may also be drawn by mixing the \* with as much salt of tartar & incorporating them with a little water, but the success of this way is more unconstant. Divers times the upper part of the receiver (carefully luted on to a large retort) hath been candied over within with volatile salts of severall shapes. & the liquor afterwards forced over hath sometimes remained long enough in form of a subtile spirit & sometimes coagulated into a lump of crystalline salt. The success hath been much the same when the salts have been mixed with out water, by grinding them well together without being deterred by the fetid smell, & distilling in a large retort. with a graduated strong fire. For the top & neck of the Retort will be lined with a pure white sublimate partaking something of the nature of the salt of ☐ though not so much as of the \*, yet differing from them both. The faetid liquor which comes over is sometimes very little sometimes more copious & the Caput mortuum which is almost all a compound salt by solution filtration & coagulation affords a pure salt of a greater dieureticall virtue then almost any other to be met with, & this salt differs enough from either of the ingredients, especially from the Alcaly, in tast & som other qualities.

Source: *The Chymistry of Isaac Newton*, <http://webapp1.dlib.indiana.edu/newton/>