

*Experiments of Refining Gold with Antimony; made by  
Dr. Jonathan Goddard.*

*The First with several parcels of fresh Antimony.*

**T**Here was taken of Crown-Gold (which is, as they call it, of 22 *keratts* fine, or  $\frac{11}{12}$ ; and the Alloy is part Silver, part Copper, more of the Copper for the most part) to the quantity of 7 *peny weight* and 10 *grains*, *i. e.* 178 *grains*. This was melted down with two ounces and two drachms of *Antimony* (about six times as much as the Gold.) And because the *Gold* was put in plates, for the more certain melting and mixture; the first *regulus* of *Gold* being separated from the *Antimony*, both were powdered apart, and the *regulus* in the Melting-Pot laid upon the same *Antimony*, and so both melted down again. In both which meltings such an heat was given, as made all of a clear light, even red heat, and boiling. Then the Pot was taken out of the fire, and all permitted to separate, settle, and cool in it. Upon breaking the Pot the *regulus* of *Gold* (being very distinct in the bottom, and easily separated from the *Antimony*) weighed 6 *peny weight* and 19 *grains* (163 *grains*.)

*N. B.* That this way of cooling all in the Pots was observed in all the following Experiments, for the more certain separation and settlement of the *Regulus*, without effusion into the *Antimony-Horn* (as they call it) or hollow Iron-Cone. Which effusion, by confounding and cooling the mixture, may be some hinderance to a more perfect separation. And to be sure, in the bottom of the Cone there is always a thin crust of the crude *Antimony*, troublesome to be separated, without taking off some part of the *Regulus*.

Note also, That *Borax* was used in every Pot, for prevention of the sticking of the *Regulus* to the bottom, and the *Antimony* to the sides of it; so that both were gotten off clean and in full quantity.

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Of the *Regulus* a piece was broken off, which weighed 1 *peny weight* 14 *grains* and an half ( $38\frac{1}{2}$  *grains*;) and was kept to be refined upon the Copel apart. The weight of the Remainder was therefore 5 *peny weight* 4 *grains* and an half ( $124\frac{1}{2}$  *grains*.)

This Remainder being powder'd and put upon equal quantity of fresh *Antimony*, as at first, (*i.e.* two ounces and a quarter) and melted down, the *Regulus* weighed 3 *peny weight* and 2 *grains*, (74 *grains*).

The other Piece of 1 *peny weight* 14 *grains* and half, being refined on a Copel from the *Antimonial* substance mixed with it (by exhalation, promoted sometime with a blast upon it, especially toward the latter end, as in all the following Experiments of Refining upon the Copel) weighed 1 *peny weight* 6 *grains* and half ( $30\frac{1}{2}$  *grains*;) and upon melting with *Borax* in a Crucible, lost not above half a *grain*. So that the weight of the whole to the Gold it held, was as  $38\frac{1}{2}$  to  $30\frac{1}{2}$ , or the Gold almost  $\frac{2}{5}$  of the whole.

The latter *Regulus* weighing 3 *peny weight* and 2 *grains*, (*i.e.* 74 *grains*) being Refined in the same manner, weighed 2 *peny weight* and 15 *grains*, (*i.e.* 63 *grains*;) the *Gold* holding proportion to the whole, as 63 to 74, that is near upon  $\frac{2}{3}$  of the whole. So that the same *Regulus* of *Gold* and *Antimony*, in passing through new *Antimony*, though it lose much in weight, yet there is not a proportionable loss of *Gold*: but is richer in *Gold*, as is proved by this and many other Trials; and so appears to sense, being of a redder complexion, more tough and harder to powder.

Both the parcels of *Antimony* being saved for separating the *Gold* remaining behind in them; they were severally mixed with equal weight both of *Tartar* and *Nitre*, and then fired, and so reduced to a *Regulus*. Then the *Regulus* of each, exhaled and blown off upon Copels. Of the first parcel of *Antimony*, wherewith the *Gold* was first melted, the *Regulus* being exhaled, there remained in *Gold* 1 *peny weight* 12 *grains* (36 *grains*.) Which upon melting in a Crucible lost somewhat, but scarce half a *grain*.

Of the second parcel of *Antimony*, wherewith the first *Regulus* of *Gold* and *Antimony* (weighing 5 *peny weight* 4½ *grains*) was melted, there remained in *Gold* 1 *peny weight* 3 *grains*, (27 *grains*.)

All the other parcels were fine *Gold* to sense, upon the *Touch*. Only that out of the first *Antimony*, was apparently unfine and pale, from the *Silver* in the original Alloy mixed with it, and not from any remainder of *Antimony*; as appeared by the inconsiderable waste upon melting in a great heat with a blast upon it: And also by the Toughness and Malleability: and by comparing it, on the *Touchstone*, with *Sovereign-Gold* allayed with *Silver*, to which it did agree, but was somewhat paler; holding, to the judgment of sense, about a fourth part of *Silver*, as the *Sovereign-Gold* doth a sixth. Neither was it altogether free from *Copper*; because, upon *Nealing*, it always turned black on the surface.

But for more exact discovery, it was taken and first Refined with *Lead* upon a *Copel*, for separation of any *Copper* that might be in it. Upon which operation, it came forth 1 *peny weight* 9½ *grains* (33½ *grains*;) which was 2½ *grains* less than it was before. Afterwards this last was melted with betwixt two and three parts of *Silver*, and so wrought in *Aqua fortis* for separation of the *Silver*: and there remained in *Gold* 1 *peny weight*, 4½ *grains* (28½ *grains*) which was five *grains* short of the former. And yet it appeared, upon the *Touch*, not fine, but paler than *Fine-Gold*, and deeper than *Crown-Gold* allayed with *Silver*. So that what remained in it was necessarily of *Silver*; and it might be estimated about 23 *keratts* fine; or to hold in fine *Gold* about 27 *grains*.

What loss of *Gold* was upon this Refining with *Antimony*, may easily be computed. First, one twelfth is to be deducted from the first quantity of *Crown-Gold*, being 7 *peny weight* and 10 *grains*, (178 *grains*) for Alloy; which is 14 *grains* and ½. So the remainder is, 6 *peny weight*, 19 *grains* and ½, or 163½ *grains*.

Then the severall parcels of *Fine-Gold* recovered and separated from the *Regulus* of *Antimony* and *Gold*, and also from the parcels of the crude *Antimony* reduced to *Regulus* are to be added together: that is to say, 1 *peny weight* 6 *grains*, 2 *peny weight* 15 *grains*, 1 *peny weight* 3 *grains*, and 1 *peny weight* 3 *grains* (the 27 *grains* last mentioned :) All which amount to 6 *peny weight* 3 *grains*. Which being deducted from the first quantity of 6 *peny weight* 19 *grains*, the difference is 16 *grains*, which is 1 tenth and 3 sixteenths of one tenth.

For a more particular estimate, where and how this loss of *Gold* ariseth, it appeareth, that the parcel of *Antimony* wherein the *Gold* was first melted, is to be charged with 163½ *grains* of fine *Gold*. Toward which, the first *Regulus* weighing 6 *peny weight* 19 *grains*, (163 *grains*) (in proportion to that piece of the same, weighing 1 *peny weight* 14 *grains* and half, and producing, upon refining on the Copel, 1 *peny weight* and 6 *grains* of pure *Gold*) must hold 128 *grains* of fine *Gold*. Then 1 *peny weight* and 3 *grains* (27 *grains*) of fine *Gold*, estimated to be contained in the 1 *peny weight* and 12 *grains*, separated from this parcel of *Antimony*, and refined both by the Copel and Parting-water (as in the former account given hereof) being added to the 128 *grains*, makes 155 *grains*: which is short of 163 *grains*, by 8 *grains*; and so much was irrecoverably lost in this parcel of *Antimony*.

The piece of *Regulus* weighing 5 *peny weight* and 4 *grains*, (or 124 *grains*.) melted with the second parcel of *Antimony* (in proportion to the former piece broke off, weighing 38 *grains*, and upon refining yielding 30 *grains* of pure *Gold*) must contain 98 *grains* of the like *Gold*, and so much this second parcel of *Antimony* must be charged with. Toward which, the *Regulus* weighing 3 *peny weight* and 2 *grains*, being refined, produced 2 *peny weight* and 15 *grains* (63 *grains*). And that *Gold* separated from the same *Antimony*, being 1 *peny weight* and 3 *grains*, (27 *grains*.) added to the former, make 90 *grains*: short of the first quantity charged on this parcel of *Antimony* by 8 *grains*.

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Some loss of *Gold* may be upon powdering of the *Regulus* (rich in *Gold*) in an Iron-Morter, (for the more certain mixture with the *Antimony* than if it were put in lumps) as also by the papers necessarily used. But it is most probable, that the greatest loss was by small sparks, which continually fly up while the *Antimony* is in a boiling heat with the *Gold*; which is always given it for the better satisfaction concerning the through melting and mixture. These Sparks appear heavy, by their rising not very high, and most of them falling down again upon the Metal and within the Pot: but many fly over into the fire.

These Sparks appear to be *Gold* thus: When the Pot was covered with a plain smooth Earthen-cover, so that many of them, upon appulse, did stick to it, and colour'd it of a deep-Red; *Aq. fortis* was first poured on, which did not dissolve or fetch off any thing: after *Aq. Regia*, which did plainly work upon that substance, and ran off yellow, like a solution of *Gold* in the same Water.

It is not improbable also, that some loss of *Gold* may be upon the firing of the *Antimony* (after the separation of the *Golden Regulus*) for reducing it to a *Regulus* with *Tartar* and *Nitre*, which make a vehement conflagration with abundant sparkling.

It hath been suspected, that somewhat of the *Gold* may be dissipated by the blast upon the Copels in refining it from the *Antimony* remaining in it. But this is not so probable; because *Gold* hath been melted several times with a greater proportion of *Regulus* of *Antimony* Simple, than is contained in the *Golden Regulus*, and refined from it with the greatest heat and blast that could be given, without any loss. And it is the constant practice of some Refiners, who to give their Fine-*Gold* a higher colour for Gilding, to put to it one third or fourth part of crude *Antimony*, or of *Regulus* of *Antimony*, and with a great heat and strong blast work it off; in which operation, in some Ounces of *Gold*, they lose not one Grain.

*The Second Experiment of repeating the Operation with the same Antimony.*

There was taken of Crown-Gold to the weight of 5 *peny weight* 21  $\frac{1}{2}$  *grains*. Which was melted with one *ounce* and  $\frac{1}{4}$  (about a sixfold proportion) of *Antimony*. The *Regulus* weighed 5 *peny weight* and 3 *gr.*

From this, a piece weighing 1 *peny weight* and 6 *grains*, broken off and reserved for refining by it self; the remainder, being 3 *peny weight* and 21 *grains*, was melted down again with the same *Antimony*, being powdered and put on the top: and thereupon the *Regulus* came forth, weighing 3 *peny weight* and 19 *grains*: so that here was no considerable loss. And there is ground to suspect, that it might be upon some accidental difference in the managing, that the *Regulus* did not so perfectly separate and settle: For in all other Experiments of melting the same *Regulus* again with the same *Antimony*, the *Regulus* gained weight; as in the next following.

From this second *Regulus*, a piece broken off and reserved for refining apart, weighing 1 *peny weight* and 12 *gr.* the remainder being 2 *peny weight* 7 *grains*, was melted down, as the former, and in the same *Antimony*. Whereupon the *Regulus* came forth in weight 3 *peny weight*; 17 *grains* being here gained to 55 *grains*, making the whole 72 *grains*, *i.e.* between  $\frac{1}{4}$  and  $\frac{1}{3}$ .

The first piece of 1 *peny weight* and 6 *grains*, being refined upon the Copel, produced of Fine-Gold 1 *p. weight* just: which holds in proportion as 24 to 30. So that it contained four fifths of *Gold*, and but one fifth of *Antimonial* substance in it.

The second piece weighing 1 *p. w.* and 12 *gr.* being refined upon the Copel, produced of fine *Gold* 1 *p. w.* and 4 *gr.* in proportion of 28 to 36, which is rather less than four fifths, as in the former; but the difference is inconsiderable for quantity.

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The *Regulus*, upon the third melting, weighing 3 *peny weight*, refined upon the Copel, produced of fine *Gold* 2 *peny weight* and 7 *grains*: This holds in the proportion of four fifths: but somewhat short of the next before.

Upon these comparisons, in this Experiment of repeating the melting of the *Regulus* with the same *Antimony*, the *Regulus* gaineth weight each time, but is in proportion less rich in *Gold*: both which are contrary, in repeating the melting of the *Regulus* with fresh *Antimony*, as in the former Experiments.

The remaining *Antimony* being reduced to a *Regulus* by firing with *Nitre* and *Tartar*, of each equal weight to it self, and that *Regulus* exhaled upon the Copel, there remained of *Gold* 19 *grains*. This was less fine than that fetched out of the first *Antimony*, in the former Experiment of passing *Gold* through several parcels of *Antimony*; though losing little sensible in weight, upon melting with a strong heat and blast upon it. So that the impurity was not from any remaining *Antimonial* substance in it; but from the *Silver* and *Copper* mixed with it in the first Alloy. And these were esteemed to be about a third part, by the judgment of the eye upon the Touch-stone. And so proved upon refining; first with *Lead* upon the Copel, for fetching out the *Copper*; upon which it weighed 17 *grains* and half, *i. e.* one grain and half short of what it was before: and then with *Aq. fortis*, after the melting down with more than the double weight of *Silver*; upon which Operation there remained 15 *grains*, and that not perfect fine, but retaining somewhat of *Silver*; but finer than Crown-*Gold* allay'd with *Silver*; upon the Touch, about twenty three *keratts*.

For computing the loss of *Gold* upon this refining from the first quantity, *videlicet*, 5 *peny weight* 21 *grains* and half, a Twelfth part, (which is 12 *grains*, save about one sixth of a grain) being deducted for Alloy, the remainder is 5 *peny weight* 9½ *grains*, and ½. And the several parcels of fine *Gold* produced of the *Regulus*, according to the ac-

count given in particular, added together; *vid.* 1 *peny weight*, 1 *peny weight* and 4 *grains*, 2 *peny weight* and 7 *grains*, and about 12 *grains* of fine *Gold* reckoned for the 19 *grains* of impure recovered out of the *Antimony*; all together make 4 *peny weight* and 23 *grains*: short of the 5 *peny weight* and 9 *grains*, by about 10 *grains*; *i.e.* as 10 to 129, or very near one thirteenth.

*The Third Experiment of exhaling the whole  
Antimony.*

A parcel of *Crown-Gold*, weighing 3 *peny weight* 10 *gr.* and half, was melted down with an ounce of *Antimony* (about the proportion of six to one); and the *Antimony* was exhaled in the *Crucible* to a *Regulus*. Then the *Antimonial* part of that *Regulus* was exhaled on a *Copel*. Whereupon there remained 3 *peny weight* and 12 *grains*: which was more than the first *Gold* by  $1\frac{1}{2}$  *grain*. This must happen, for want of a heat strong enough at last to force off all the *Antimonial* substance. Whence afterward, upon melting in a *Crucible*, it came short 4 *grains*; *vid.* 3 *peny weight* 8 *grains*, which was but  $2\frac{1}{2}$  *grains* short of the first quantity, and is the least part of the proportion of *Copper* that must be in it, according to the usual Alloy of *Crown-Gold*: which is generally two parts to one of *Silver*, or at least the half.

So that *Antimony* in a far greater proportion, doth not so much, as *Lead*, in exhaling or separating *Copper* from *Gold*; if the work be done meerly by Exhalation: but doth only retain it with it self, whilst the *Gold* separates and settles in a *Regulus* at the bottom. Neither is it destroyed, but that it may, in part at least, be united to the *Gold* again.

That



That there remained *Copper* in this *Gold*, appeared farther by the black complexion of it upon Nealing. As also by the loss upon working it with *Lead* on a Copel: whereupon it came forth 3 *peny weight* 4 *grains*, i. e. four grains short.

*A Relation of a Monstrous Birth, made by Dr. S. Morris of Petworth in Suffex, from his own observation: and by him sent to Dr. Charles Goodall of London; both of the Colledge of Physicians, London.*

**A**T *Petworth, Decemb. 20. 1677.* one *Joan Peto*, a Butchers Wife, after most acute pains was by her Midwife delivered of a monstrous Female Birth.

It had two Heads Both the Faces very well shap'd. The left Face looked Swarthy: and never breathed. And the left Head was the bigger; and stayed longer in the Beating. The right Head was perceived to breath; but not heard to cry. Betwixt the Heads was a protuberance, like another Shoulder. The Breast (and Clavicles) very large; about seven Inches broad. But two Hands. And but two Feet. *Parvus* hath a Figure answerable to this Description, excepting the Protuberance above-said.

As to the Inwards: the Brain, in each Head, was very large. The *Spina Dorfi*, from the Neck to the Loyns, was double. There were also two Hearts, one on each side the *Thorax*. The left Heart the bigger. And two pair of Lungs; one infolding each Heart. Those in the left side were blackish; the other looked well. The *Mediastinum* parted the two Hearts one from the other.

The *Aorta* and *Vena Cava*, below the Diaphragm, single: the Diaphragm having only three perforations, as is usual. But a little above it they were each divided into two Branches, distributed to the two Hearts in the figure of a