An Accompt of three Books,

1. *A Discourse made before the* R. Society, *concerning the Use of DUPLICAT PROPORTION in sundry Important Particulars; together with a New Hypothesis of ELASTIQUE or Springy Bodies: By Sir* William Petty *Knight, &c.*

THE Author of this Discourse, much addicted to apply Speculations to Use and Practice, hath given in this Exercise of his, *Several Instances, wherein the Consideration of Duplicat and Sub-duplicat Proportion, or the Consideration of Sides and their Squares is of Use in Human affairs.* Those Instances are.

1. In the *Drawing or Driving Powers*, which force Ships or other Bodies through the Water, with reference to the respective *Velocities* caused thereby.

2. In the *Shapes or Sharpness of Bodies*, cutting or dividing the Water, through which they are driven or drawn, and in the different Velocities arising from thence, where the Bodies and Forces are Equal.

3. In the *Strength of Timbers*, or other Homogenous materials applied to Buildings, to Carts, or any other Machinaments intended for Strength: And how by a *Model* to judge the Sufficiency of such Engine as is represented by it.

4. In the *Effect of Oars* upon Equal and Like Vessels, according to their Numbers, Length, Blades and motions *with* or *against* the Stream of smooth or un-even waters.

5. In the Motion or *Travelling of Horses*, on their several Paces, and with different Burthens on them.

6. In the *Strength* and *Velocity of Mills* and their Wheels.

7. In the effects of *Gunpowder*.

8. In the Distance at which *Sounds* may be heard.

9. In the Distances at which *Odoriferous matters* may be smelt.

10. In the Distance at which the *Objects of Sight* may be seen.

11. In the Time of the Returns made by *Vibrating Penduls*.

12. In the *Lives* of Men and their Duration.

13. In *Musical* and *Sounding* Bodies, such as Strings and Bells.

14. In the Effects and Motions of *Fire* and *Burning Spirits*.

15. In the *Rising* and *Falling of Bodies*, but especially of Water in *Pumps*, *Over-shot Mills*, *Leaks* in Ships, the *Heights of Rivers* at their Head above their fall into the Sea.

16. In *Bellows*.

17. In the *Prices* of several *Commodities*, as Masts, Diamonds, large Timber, Amber, Load-stones, *&c.*

18. In *Mill-dams*, *Sea-banks*, and the *Bulwarks* or Walls of Fortreſſes.

19. In the *Compreſſion of Wool* and other *Elaſtique Bodies*, and of the *Air* within Diving Veſſels, as alſo in the Effects of *Screw-preſſes* upon ſeveral Materials.

Having thus enumerated his ſeveral Inſtances, wherein *Duplicate* and *Sub-duplicate Proportion* is of great importance, he explaines what he underſtands by every material word he uſes in this Diſcourſe, ſuch as *Matter*, *Body*, *Figure*, *Place*, *Motion*, *Quantity*, *Quality*, *Habit*, *Time*, *Proportion*, *Weight*, *Swiftneſs*, *Force* and *Elaſticity*. This done, he falls to his main buſineſs, which is the Application of the ſaid Proportions to each of the reſpective Matters lately mention'd. To which he ſubjoyns an *APPENDIX* touching his new Theory of *Elaſticity*, mechanically explicated, to draw forth the Thoughts of other men for Countenance or Correction. This Hypotheſis the Author hopes will ſolve *all* the Phænomena of *Elaſticity*, and not only ſo, but alſo thoſe of *Hardneſs*, *Fixedneſs*, *Tenacity*, *Fluidity*, *Heat*, *Moiſture*, *Fermentation*, &c. Not to prejudice this his Explication by transferring it hither in a Breviat, we ſhall referr the curious to the Author's own Diſcourſe; wiſhing, that whatever *Effects* of *Springineſs* do occur to the Ingenious Reader, he would pleaſe to examine them by the Principles deliver'd by the Author.

Theſe are the particulars, perform'd in this Diſcourſe, which the Author judgeth, may paſs for a Sample, *pro tanto*, of what the *Royal Society* is doing. For, the ſaid Diſcourſe conſiſting of three parts, *viz.* 1. An Explanation of the Intricate Notions, or *Philoſophia prima*, of *Place*, *Time*, *Motion*, *Elaſticity*, &c; 2. An excitement of the World to the ſtudy of the Mathematiques, by ſhewing the uſe of *Duplicate Proportions* in ſome of the moſt weighty of Human affairs; and 3. A Propoſal of conſidering, without Chymerical Speculations, ſuch points and properties in *Atomes*, as may give an *Intelligible* Accompt of the Nexures, Mixtures, and Mobilities of all the parts of the Univerſe: The Diſcourſe, I ſay, conſiſting of theſe parts, he eſteems, that in like manner 'tis the profeſſion of the ſaid *Society*, to make myſterious things plain; to explode and diſuſe all inſignificant and puzling words; to improve and apply little ſmall threds of Mathematiques to vaſt Uſes; and yet not to neglect the fineſt Conſideration, even of *Atomes*, where the ſame is neceſſary.

II. *The*

II. *The ſecond Book of the ART of METTALS, wherein is taught the Common Way of Refining Silver by Quickſilver, with ſome New Rules added for the better performance of the ſame: Written in Spaniſh by* Alonſo Barba, *and Engliſht by the Right Honorable* Edward *Earl of* Sandwich, *London*, 1674. in 8°.

THE *firſt* Book of this ſubject was diſcourſed of in the next foregoing Tract. This *ſecond* conſiſts of 24 *Chapters*, moſt of them practical; whereof the *two firſt* do inſtruct the Reader, *with what care and caution a Refiner of Mettals is to be employed*, and *what knowledge ſuch an one is to be furniſh't with*, viz. that he is to know the qualities and differences of all ſorts of Mettals and Minerals, which of them are moſt proper for Quickſilver, and which for melting; *item*, the Diſeaſes infecting Mettals, and the way of clearing them; as alſo the Accidents of Quickſilver, and the way of Refining both in great and little; and above all, the manner how to make the leſſer Eſſay, by the fire, of Ore ground to powder before the Mettal be incorporated together, that ſo he may certainly know how much Silver (e. g.) is to be gotten out of the Ore of that Mettal: The want of which knowledge and care, *our Author ſaith*, hath coſt the kingdom of *Peru* abundance of mony, and is ſtill of great prejudice to it; which he proveth by very conſiderable Experiments, whereby it was made evident, that a vein of Mettal, eſſayed by the Fire, yielded 900 pieces of Eight the Quintal, which by the ordinary way of Quickſilver yielded but four or five: *item*, that another Mine, which by the common Eſſay with Mercury appeared to have ſcarce any Silver at all in it, yet by the other way contained 60 pieces of Eight the Quintal.

The *third* Chapt. treats of the *knowledge of thoſe above-intimated differences of Mettals:* The *fourth* teacheth the *way of ſorting Ores, and the proper manner of Refining each of them:* Where 'tis made out, that to eſſay that Mettal by Quickſilver, which requires the fire, is to deſtroy it; as 'tis to looſe the profit, if that Mettal be put in the furnace, which is not to run: And further, though the ſeveral Ores be fit for the Quickſilver, and ſome for Fire, yet even herein they have their differences of being eaſier or harder to be refined, according as they concur or differ in the remedy that is neceſſary to be uſed for that purpoſe.

The *fifth* Chapt. informs us, How to know the ill Qualities that infect the Ore, and how to purge them away: Where 'tis noted, that ſuch Ores, as partake of *Copperas*, will not endure Quickſilver, but conſume and ſcatter it; which our Author ſaith may be eaſily

tried by mixing a little Quickſilver with well-ground Copperas and Water; whereupon he ſhall in a trice ſee all the Quickſilver diſſolved and loſt, eſpecially putting a little Salt to that compoſition. How this, and other like inconveniences are found out, and how eaſily they may be remedied, may be ſeen in this Chapter at large.

The *ſixth*, *ſeventh* and *eighth* Chapters, treat of the *Grinding* and Burning of Ore, and the damage that reſults from this Burning. In the buſineſs of *Grinding*, 'tis beneficial to grind the lumps over again, and to grind them very ſmall: to which practiſe our Author adds another way of preparation, *viz.* by Boyling, held by him more proper in all refinings by Quickſilver. As for *Burning*, that is uſeful, not only, that the Ore may grind the better, but alſo, that it may be better diſpos'd for the Quickſilver to lay hold on, and incorporate itſelf with the Silver it contains: which burning yet is not to be uſed in Ores that are mixt with Copperas, the mortal enemy to Quickſilver; the fire not only vanquiſhing, but on the contrary increaſing that ſubſtance; of which therefore all Ore, wherewith 'tis mixed, is firſt to be clear'd by well waſhing it.

The *ninth* delivers ſeveral *Experiments*, *proving the damages by the Burning of Ore*, *if they be not known and remedied.* And the *tenth* examines, *Whether the Ore ought to be burnt in the Stone*, *or in the Meal*; as the *eleventh* aſſigns the *Materials to be mixed with Ore when 'tis burnt:* Where occaſion is taken to repreſent, that the Diſeaſes of Ore may be known by putting a little of it, ground ſomewhat groſs, upon a red-hot plate of iron, obſerving well what fume it makes; which if it be white or black, it participates of Bitums of that colour; if yellow, of Orpiment; if red, of Sandaraca; if yellow in the middle and green on the outſides, of Sulphur, *&c.*

The *twelfth* and *thirteenth* teach the Refiner what he is to do before he incorporates the † *Caxon* for refining: Where alſo are ſet down the Signs, ſhewing, when the ſeveral Ores, diverſly mixed and handled accordingly, are diſcharged either of all their Sulphur and Antimony, or of their Bitum, and the like; as alſo, when an Ore is well diſpoſed for the Quickſilver, and when not, *&c.*

† That is, *a Cheſt full of Ore ground to be refined,*

The *fourteenth* and *fifteenth* conſider *the nature of Quickſilver*, *and the Cauſes and Differences of the Refiners* Lis *of Quickſilver*, as 'tis call'd, which is Quickſilver divided into very ſubtile parts, which diviſion is cauſed by the often paſſing of it through the Ore although

although it hath no ill quality at all; but if it hath Copperas *in it*, it will grind the Quickſilver in great extremity. Now if Quickſilver be without any forain impreſſion upon it, and be diſſolv'd into *Lis* which is white, 'tis call'd, as was juſt now ſaid, *Lis* of Quickſilver; but *Lis* of other materials is call'd that which is made by Quickſilver of Tin or Lead; and *Lis* of Silver is the fine and ſubtile parts of Silver, made by the repaſſing of the Quickſilver through the Ore, but not as yet joyned and incorporated with it; which when it is, they call it *Pella*, that is, Ball or Pellet. As to the *Nature* of Quickſilver, 'tis a body of ſo admirably uniform a ſubſtance, and of parts ſo perfectly united, that even the fire, which ſeems to be its greateſt enemy, is not powerful enough, by dividing, to corrupt or deſtroy it, as it viſibly doth all other metals and bodies, except Gold and Silver.

The *ſixteenth* examins, *Whether it be fitting, at firſt to put in all the Quickſilver and other Materials at once, or no*? This Author is for the negative, alledging his reaſons for it, and eſpecially Experience, by which, he ſaith, 'tis found, that the extraordinary cold of much Quickſilver doth accidentally bind up the Ore, and hinder the refining. Which damage, *he ſaith*, follows alſo, if men exceed in the quantity of other materials, they put into the Ore that needs it, becauſe it ſo dulls the Quickſilver, that it will lay hold on no Silver at all; which therefore will very hardly ever be reduced into that condition it ought to be. Yet he adverties withal, that if it be needful to refine with *Lime*, his rule will not ſerve in that caſe, but the Lime muſt be put-in all at once, taking eſpecial care, that you do not put in too much of it, becauſe that that greatly hinders the Quickſilver from laying hold of the greater plate.

The *ſeventeenth*, diſcourſes of the *Often repaſſing the Quickſilver through the Ore, and the Effects thereof*: And the *eighteenth* and *nineteenth*, enumerate divers *Accidents, which happen in the way of Refining by Quickſilver, and their Remedies*: Where he obſerves, that if the Quickſilver be very much charged, above what it ought, with materials, ſuch as Lead, Tin, Iron, Lime, it will not appear orbicular, but prolonged like little worms, and if it be ſtirr'd about the Tray without water, it will make drops with little tails, and ſtick to the ſides of the Tray: And when it is of this condition, 'tis a ſign, *ſaith he*, that 'tis killed or its virtue obtunded from laying hold on the Silver. Which evil how 'tis to be remedied, is at large declared in the ſame Chapters.

The *twentieth* and *one and twentieth*, inſtruct us, *How to know, whether*

whether or no the Caxon be ready for waſhing: And, *that the waſhing of the Caxons cauſeth the loſs and waſte of Quickſilver.* As to the *former*, he ſhews, that no ſmall experience is neceſſary to know that particular; ſince, if the Caxon be not ripe for waſhing, that plate which the Quickſilver hath not laid hold on, is likely to be utterly loſt; or, if it be not, it muſt be ground over again. And here he ſets down a ſure and infallible rule, as he accounts it, for the diſcovery of the diſpoſition of the *Caxon*; reflecting on the rules hitherto deliver'd for that purpoſe. As to the *latter*, he aſſerts, that the immediate cauſe of that miſchief of the Quickſilvers imperceptible getting out of the *Caxon* with the water or the *Lamas*, is, when the Quickſilver is made over-thin without body or weight, as 'twere, ſo that it hath nothing to ſink it to the bottom of the Caldron, and with ſtirring the *Caxon* when they waſh it, it mixes itſelf with the dregs and dirt, and goes along with them.

The *two and twentieth* ſets down the *True cauſes of the loſs of Quickſilver, and their Remedies.* Where the Author makes the repaſſings to be the remote cauſe of waſting the Quickſilver, and Copperas to be of its own nature, as hath been already noted, a violent cauſe of extenuating the Quickſilver, and of deſtroying the greateſt part that hath been waſted of the ſame. In the working of which ill effect, the Salt, uſed in Refining, and in waſhing the *Caxons*, contributes not a little; as the *Lamas*, mingled with the water, thickens it, and reſiſts the ſinking of the Quickſilver, which ſtays and is thrown away together with it. See the Remedies in the Author himſelf.

The *three and twentieth* and *four and twentieth*, do explain the *way to make the* Pine-Apples, *and to clear them of the Quickſilver.* When Refiners have taken the Plate and Mercury together out of the Caldron, ſtraining it, to make them the thicker through two courſe cloaths wetted, and when they have alſo beaten it with a Batledoor to ſqueeſe as much Quickſilver through the cloaths as is poſſible, they make *Pine-apples* of the dry Pellets in moulds fitted for that purpoſe, ſo call'd from their ſimilitude to that fruit, by reaſon of their pyramidical figure: Of which *Pines* thoſe that have been reaſonably well ſtrained, $\frac{1}{5}$ will be Silver; ſo that 100 pounds of Pellets will produce 20 pounds weight of Silver. Here the Author takes occaſion to relate the vaſtneſs of the loſs in clearing the Ore again from the Quickſilver, which he proves from Experience, whereby it appear'd, *he ſaith*, in the City of *Potoſi* alone, at the time of his writing, when the Trading in Mettals ran but low, that yet

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communibus annis above *thirty thouſand* pieces of Eight were waſted by the expence of Quickſilver: Which inconvenience hath proceeded, in his opinion, from want of care in ſeeing the Veſſels, uſed in the recovering of Quickſilver, made of good ſtuff, and ſhut very cloſe. Where he takes notice, that at *Oruro*, famous for Gold and Silver-mines, on the top of a hill there is a little vein of white Earth, whereof they make Veſſels for uſe, which when baked become ſo cloſe and firm that they are not inferior to the beſt *China*, and are very uſeful for the making of Crucibles. But where ſuch Earth is wanting, he directs, that that Clay, which is ordinarily uſed in making the veſſels for recovering the Mercury, be the better mingled with the ſcum or droſs of Iron ground very fine, and ſo made up and baked very well; and that then there ſhall not be ſo much Quickſilver loſt in the uſe of them, as is by thoſe now in common uſe, *&c.*

III. *Animadverſions on the Firſt part of the MACHINA CÆLESTIS of the deſervedly famous Aſtronomer* Johannes Hevelius, *&c. together with an Explication of ſome INSTRUMENTS, made by* Robert Hook *P. of Geom. in* Greſh. Coll. *and Fellow of the Royal Society.* London, *for* John Martyn *Printer to the R. Society, at the* Bell *in St.* Paul's Church-yard, 1674.

THIS Piece conſiſts, as the *Title* intimates, of two main parts. The *One* repreſents the Authors thoughts of the *Aſtronomical Organography* of the Excellent *Hevelius*, both examining *his*, and *Tycho Brahe*'s Inſtruments, and undertaking to evince, that if they had made uſe of *Teleſcopical Sights*, their Obſervations might have been much more exact than they are; foraſmuch as, in the Author's opinion, an Inſtrument of *three* foot *radius* with Teleſcopes, will do more, than one of *ſixty* foot *radius* with Common Sights. The *other* deſcribes an Inſtrument for taking all ſorts of Angles and Diſtances in the Heavens, which, if increas'd in bulk, is capable, ſaith Mr. *Hook*, of as great accurateneſs, as the Atmoſphere will ever permit Cœleſtial Obſervations to be made. Its perfection he places in theſe *ſeven* particulars: 1. In the *Sights*, which are ſuch, *ſaith he*, as may be made to diſcover the minuteſt part diſcoverable in an Object, not at all ſtraining the eye, and fit for all eyes. 2. In the *Diviſions*, which are ſuch, as will diſtinguiſh the Angle as minutely as the Sights will diſtinguiſh the parts or objects, and that even to *Seconds*. 3. In ſuch a contrivance of the Sights, that with one glance of the eye, both the Objects, though a Semi-circle diſtant; are *at once* diſtinguiſh't and

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ſeen together. 4. In the Method of ſetting it exactly perpendicular to a *Second*, if need be. 5. In its *Fixation* and *Motion*, it being ſo fixed and moved, that, if once ſet to the Objects, it continues to move along with them, as long as 'tis neceſſary to continue, or be very certain of, any Obſervation. 6. In its being to be made and adjuſted without difficulty, and not to be put out of order without deſign; as alſo in its great eaſineſs of being rectified and again adjuſted. 7. In its being not very chargeable.

All theſe perfections the *Author* explains, and endeavours to make good, by deſcribing and delineating this Inſtrument and all the parts thereof, and endeavouring to obviate ſuch exceptions, as he fore-ſaw might be made againſt it. To all which he annexes occaſionally ſomething that relates to the priority of the Invention of the *Circular pendulum*; and likewiſe a Deſcription of a Wheel-work, which, *he ſaith*, may be called the perfection of ſuch work, having the perfecteſt Idea, he thinks, that toothed Wheel-work is capable of, performing the ſame effect, as if the Wheel and Pinion had an indefinite number of Teeth. Which done, he deſcribes the Frame for keeping the Inſtrument, which is the main Argument of this Book, in its Perpendicularity, and yet always in the *Azimuth* of the Cæleſtial object; with a Digreſſion of the great Uſe of this Principle in Dialling, Equalling Time, Clock-work, *&c.*

He mentions alſo a Mechanical way, he hath, of calculating and performing *Arithmetical* operations, much quicker and more certainly, than can be done by the help of *Logarithmes*.

He concludes the whole by ſhewing divers of the particular Uſes of this New Quadrant, as 1. For meaſuring the Refraction of the Air. 2. For regulating the Places of the Fixt Stars and of the Planets. 3. For ſtating the Latitude of Places. 4. For examining the Influences of the Planets on the Earth. 5. For meaſuring the quantity of a Degree upon the Earth, 6. For meaſuring ſeen Diſtances. 7. For Levelling. 8. For taking the Diameters of the Sun, Moon, and other Planets. Where, by the by, are mention'd two other Inſtruments, one for taking Diameters to *Seconds*; the other, for looking on the body of the Sun without harming the eyes.

Errata left uncorrected in Numb. 108.

Pag. 170. l. 20. r. *Stores of Salt.* p. 185. l. penult. r. *ſometimes to the thickneſs of a ſtem.* p. 187. l. 15. r. *bought.* ibid. l. 30. r. *did coagulate.*

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