

PHILOSOPHICAL TRANSACTIONS.

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Some Observations and Experiments about Vitriol, tending to find out the Nature of that Substance, and to give further Light in the Inquiry after the Principles and Properties of other Minerals: Communicated by a Fellow of the R. Society, who maketh Use of Chymistry chiefly as subservient to Physiology.

VITRIOL is by the Spagirical Tribe reputed one of the chief Pillars of Medicine and Alchimy, and is indeed endowed with many excellent and truly admirable Properties, being employed by Nature in her most Curious Mineral Operations. Tis it self one of the most noble and useful

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Productions, and therefore deserves our special Consideration. I do not pretend to render a Mechanical Account of its Generation, nor a History of all that may be performed by its Mediation in Medicine, or Chymistry; my Design is only to furnish inquisitive Persons with some Observations and Experiments, which will probably enable them more easily to investigate the Nature of this *Protean* Substance, as also afford some further Light unto them in their Inquiry after the Principles and Properties of other Minerals. *Vitriol* is of several Kinds, being, for Colour, White, Yellow, Green, or Blue; usually of the Two last mentioned: And is made either of Mineral Waters boiled up to a convenient Consistence, then set to ChrySTALLize, or extracted by common Water out of Earths impregnated therewith. 'Tis also afforded by many Sorts of Stones, commonly called *Pyrites* and *Marcastites*, which exposed some Months unto Aerial Influences, are resolved into Powder, and the Saline Part dissolved in Rain, or other Water, then boiled and set to shoot, yields Store of *Vitriol*, especially with the Addition of Copper, or Iron. It is often associated with Earth and Stones, wherein Mettals are contained; and with many natural Recrements of Mettals, such as *Misy*, *Sory*, *Chalcitic*, from which 'tis usually separable by the common Method with Water, sometimes not to be extricated until the Mineral be first calcined, or burnt. It is also frequently found pure and perfect in the Caverns of the Earth, being an Efflorescence of several Minerals; and this is accounted by all Naturalists the best, both for Medicinal and Spagirical Uses. *Lastly*, It is copiously contained in common Mineral Sulphur, as I shall anon fully evince. *Vitriol* usually accompanying most Mettals and Minerals, many do apprehend it is always one of their component Principles, at least a necessary Cause of, or Agent in, their Production; which, if meant of the Acidity, or Saline Part of *Vitriol*, seems highly probable; as I shall manifest at large in the ensuing Discourse. But first, I think it expedient to examine what are the constituent Parts of *Vitriol*, whereby we shall be better enabled to judge of its Nature and Properties.

Vitriol consists of insipid Phlegm, Earth, or Oker, some Mettal, Mineral Sulphur, an acid Salt, or Spirit, together with

with some small Portion of the Volatile Aerial Salt.

That it contains *Water* needs no great Proof, since no Saline Substance can cristallize without it; and Distillation will convince any Person, that it exceeds in Quantity any of the other Principles.

The *Earth*, or *Oker*, may be thus separated: Dissolve Vitriol in fair Water, immediately a yellow Powder will separate, and in a short Time subside: The greater the Quantity of Water imployed, the more Oker precipitates: The weaker the *Lixivium*, the less able to support Bodies more ponderous than common Water: And the lighter the Water (as if distilled Rain-Water, or Phlegm of vinous Spirits) the more earthy Parts subside, upon the same Hydrostatical Principle I just now mentioned. I have above twenty Times repeated this Dissolution, seconded by Filtration and Coagulation, and each Time separated some Quantity of this Earth, and am perswaded, had I long continued the Operation, the Success would have been the same; only I observed the Quantity separated each time sensibly to diminish: And *Basilius Valentinus* assures, that at length the Vitriol will let fall no more Sediment, and that then it is the Subject of most noble Operations by him particularized; which they, who have Leisure and Confidence in his specious Promises, may do well to try. I have found a more easie and expedite Way of effecting this Separation, which may be of great Use to them who work on Vitriol, much abbreviate their Labour, and considerably lessen their Expence.

Take a good Quantity of the common *Dantzick*, or *Hungarian* Vitriol, having powdered it, put it into a slender Cucurbite, place it in Water, keep under it an equal constant Fire three or four Days: The Vitriol without Additament will become fluid, as if dissolved in Water, and the Oker with most of the Metalline Parts, with the gross Sulphur, will subside, and become a hard Cake at the Bottom, the Vitriol being fluid above it, which in the cold again Crystallizeth, excepting a small Quantity of Liquamen of the same Nature with that we shall hereafter mention: This repeated once or twice, the Vitriol attains unto a high Degree of Purity, and is easily capable of many Alterations, whereunto it was subject be-

fore this purification. This operation will not succeed in a dry digestion; I mean, Ashes, Sand, Filings of Iron, Steel, open Fire, or even flame of Lamps, whether fed with Oil or Spirit of Wine. This Earth may also be obtained in a great proportion, though in another form, if after a long and intense Calcination the Vitriol is freed from its remaining Salt by frequent ablutions with warm Water: The far greatest part of this dulcified Colcothar is insipid Earth with some small proportion of Metall. The same may be precipitated by Salt of Tartar, or any other Alcalies, or filings of *Zink*, or other immature Minerals, out of a solution of Vitriol in common Water: It being also separated from Metalline and Saline parts, by a method I shall hereafter mention, there remains a great quantity of an insipid substance nearly resembling burnt Allom: Besides, whereas *Salt*, *Nitre*, &c. require in distillation a large quantity of Earthy substance to disjoyn the Saline parts, and prevent fusion; Vitriol and Allom need it not; an unquestionable proof, that Earthy parts abound therein.

That Vitriol contains *Sulphur*, is evinced by the Sulphureous smell it emits in distillation, especially if urgent with a strong fire from the beginning, and the Spirit thus drawn being rectified, the Liquor, which first arises, hath a highly Sulphureous smell, as hath also that we shall hereafter mention, distilled from Vitriol deprived of its Metallick Parts. The *Colcothar* dulcified, or Metallick parts precipitated by an Alcali, or immature Mineral, sublimed with Sal Armoniack, an inflammable Sulphur may be many ways separated both from the sublimate and *Caput mortuum*. The common Oil of Vitriol digested on Antimony, then distilled, yields a much greater quantity of Sulphur, than would have been produced, had any other acid Liquor been employed; and the same Oil of Vitriol digested with Spirit of Wine, and distilled, yields an Oil, and at the latter end store of Sulphureous Inflammable Flowers.

As for the *Acid Saline Principle*, I suppose no person who hath tasted the Spirit of Vitriol, and that abusively, called, its Oil, will question its abounding in that subject.

Some add unto the Principles, we have enumerated, the
Salt

Salt to be separated from the *Colcothar* after distillation; which I omit, Experience having learned me, that it is of the same nature with the former, only somewhat more fixed; and if the Spirit be cohobated from the *Caput mortuum*, it is with the rest volatilized, nothing remaining besides Metal and insipid Earth.

The *Saline* Principle being that whereon I intend chiefly to insist, I shall enquire whence it derives its Original? what subject it doth most resemble? or with what 'tis most nearly allied? In order to the resolution of these Enquiries, and the confirmation of certain Propositions, hereafter to be mentioned, I shall premise some Experiments, made many years ago, which perhaps may give no less satisfaction unto many of our Experimental Philosophers, than they afforded me, when I first made mine.

I took four or five Gallons of the Vitriolate water, which was conveyed, by artificial Channels at *Deptford*, from the beds of *Pyrites* or *Marcesites* into the great Cistern. I distilled therefrom in glass Vessels two thirds of insipid water; letting the Glasses cool, the water let fall a Vitriol of a lovely dilute Colour, (whether green or bluish I do not remember,) together with a great quantity of that yellow Sediment which we formerly called *Oker*: Then evaporating a third part of the remaining Liquor, I received more Vitriol of a paler colour than the former, and *Oker* as before, though less: The fifth time this operation was repeated, instead of Vitriol it afforded a yellow, and ever after a white, Salt, which did differ exceedingly from Vitriol, not only in colour, but also taste; being fiery and pungent; did partake little of that abominable rough astringent smack which is peculiar to Vitriol. It was almost unctuous, like Salt of *Tartar*; made the hands soft and supple, cleansing like a *Sapo*; whereas common Vitriol renders them rough, and harsh: Being dissolved in water, it appeared to the very Eye very fatty and oleaginous.

Among many other appearances sufficiently remarkable, in this last liquor and Salt, I shall only mention these few;

1. *Obs.* From five pounds and a half of *Lixivium*, I received four Pounds of this fiery white Salt, besides half a pound

found of *liquamen*, which remained fluid, and would not coagulate. I do the rather mention this; for that is one of the most eminent Instances, I ever met withal, of so great a quantity of Salt kept fluid in the cold by so small a quantity of water.

2. The remaining *Liquamen* was very fiery, acidly pungent, and extremely ponderous; no whit inferiour, in my opinion, in any of these respects, to common Oil of Vitriol; it seeming to me strange, and unusual, that so strong a Liquor should be obtained without any considerable Degree of Fire.

3. This *Liquamen* being exposed unto the Air, soon *attracted* (if our Criticks will permit me to use such an Expression,) double its quantity of Moisture. I cannot recollect, that I did ever observe any fluid Body, which approached near unto it for this Property; though I am not ignorant, that all Corrosive Saline Liquors will borrow considerably from their neighbouring Element. And I remember, that divers eminent Chymists have delivered several Preparations of Vitriol, which derive Moisture from the Moon more or less, according unto her several *Phases*; which I am perswaded is a meer Dream, having seen little hitherto that should perswade me, any of the Planets do influence otherwise than by Heat and Light. And I always observed this *Liquamen* to acquire more or less Moisture, according to the Constitution of the Season, rising sensibly in moist Weather, and little in dry, without any respect unto the Moon, or other Planets; which I can the more positively determine, having for several Months made accurate Observations with conveniently shaped Glasses. But to return from whence we digressed;

The white Salt last mentioned was distilled in a Sand-furnace, and the far greater part came over in the form of a Spirit highly acid, especially that which came last in small Drops. This Liquor rectified in a very tall Body, immediately upon the approach of the smallest Degree of Heat a volatile Sulphureous Spirit did arise, clear as Rock-water almost, nay I think altogether insipid; yet the smell so subtle and penetrating, that 'twas insupportable: And such it continued many years, not letting fall any sediment, and thereby losing its strength, as doth the volatile Spirits made out of
common

Common Vitriol. The Spirit which remained after the separation of the more Volatile, was in all respects like that of *London* Vitriol; only seem'd more gratefully acid, and might, like it, be separated into Spirit, and Oil, corruptly so stit'd.

Vitriol freed, as is before declared, from its Earthy and Metallick Parts, by *Zink*, or other imperfect Minerals, is much of the same nature, and yields its Spirit in Sand, as this we have now mention'd: Is also White, and more unctuous; hath a Grain more like Nitre than Vitriol; as hath also the *Goslar* Vitriol, which is White, and comparatively unctuous, because it hath little Mettal, and less Mineral-Sulphur than the Common; whose Mettalline Part detains the Saline, and will not dismiss it until long urged by a very intense degree of heat. What remained in the Retort, after this distillation, was not red or purple, like the *Caput mortuum* of Common Vitriol, but white, light, and spongy, like burnt Allom, and altogether as insipid; although, after it was sometime expos'd unto the Air, it received many strange Impressions and Alterations; which, though very remarkable, I omit, as not answering my present Design, which is to enquire, whence the Saline Principle in Vitriol proceeds, and how it comes to be so compounded? But first, I cannot but take Notice of the great Affinity that is between *Vitriol*, *Allom*, and *Mineral Sulphur*; the Saline Principle, which is in each of them by far the Chief, both in Quantity and Energy, having one Nature and the same Properties; although in the last clog'd with a small Portion of Sulphur. For notwithstanding what is commonly received, I shall clearly prove, that the Body of Common Sulphur is a Vitriolate Salt, the very same with that, which is separable from Common Vitriol; and that the Sulphureous Parts are not only less copious, but inconsiderable for bulk, compared with the Saline, which are sincere Vitriol, not differing from the Common; only that doth not so much abound in Metallick and Earthy Particles.

So far the Author for this time, having been unexpectedly interrupted to proceed in this Design, which he hath promised to finish for the next Opportunity.

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