PHILOSOPHICAL TRANSACTIONS.

Novemb. 23. 1674.

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A Continuation of Dr. Daniel Coxe's *Discourse, begun in* Numb. 107. *touching the Identity of all* Volatil Salts, *and* Vinous Spirits; *together with two surprizing Experiments concerning Vegetable Salts, perfectly resembling the shape of the Plants, whence they had been obtained.*

THat which hath been said of *Alcalizate* Salts, may likewise be affirm'd concerning *Volatil Salts*, and *Vinous Spirits*: The former are afforded not only by Vegetables and Animals, but also by some Minerals: And although immediately upon their production or extraction out of the several substances which did yield them, they appear sensibly different from each other, and are without dispute endow'd with very different properties, chiefly Medicinal; yet they may all by slight artifices be reduced unto such a Simplicity and Identity, as that neither the most acute and faithful Senses, nor the most rational and nice Experiments, can find or make, without additaments, the least disagreement or discrimination.

Volatil Salts abound in most Vegetables, from which they sometimes may be extricated by simple Distillation; but usually prævious Fermentation is required: of which operation I have formerly

*See Numb. 101. rendred a particular Accompt *. This Salt may also be obtain'd from *Soot*, *Urine*, the *Blood* of Men and other Animals; from *Bones*, and especially *Cranium*'s or Skuls of Men; from many sorts of *Horns*; (and indeed no subject yields them so copiously, as those which are annually cast by *Staggs* or other Deer;) from Vipers in great plenty; as also from divers other Animals. I need not here mention *Factitious Salt Armoniack*, that being a commixture of several of the mention'd Substances with Sea-Salt. Also many Minerals and Fossils contain Volatil Salt; vast quantities of Salt Armoniack being found in many parts of the *East*; which was probably sublimed into those Caverns, whence it is extracted by the force of Subterraneal Fires: Which conjecture is sufficiently authorised by the same Substances being gather'd near the *Crateres* or Mouth's of our *European* Vulcans of *Ætna*, *Hecla*, *Vesuvius*, *in Campis Phlægreis*; in *England* also near the Mouth's of several Coal-Mines which have been accidentally fired: And of recent memory that Torrent of melted Minerals, which boiled over the Crucible (if I may so speak) upon the late Conflagration in *Sicily*, and poured it self into the adjacent Plains. This liquid Fire, as it cooled, condensing, became crusty at top, and almost every where Stones of Salts were sublim'd or thrust forth by the violence and fury of the Heat. Some of these Salts resembled the vulgar Sea-Salt; others, Niter; some were of an Aluminous and Vitriolick nature; but that which was most copious and universal, was Armoniack; which although much discoloured, and rendred very impure in most places by its union with various metallick and mineral particles, yet did chiefly, as the Factitious Salt Armoniack, consist of Marine and Volatil, commonly call'd *Urinous* Salts, as did also the fore-mention'd; as many Experiments have inform'd me, too numerous and tedious to be here inserted. Besides these Mineral Substances already mention'd, several sorts of Earth, Clays and Marle, which are fetch't from the Superficial or Cortical part of the Earth, do contain store of Volatil Salts; which appear upon Distillation: And from some of them I my self have frequently separated greater quantities than will be easily credited. It would waste more time and paper, than I am willing to lose, and require more patience in the Reader than the Subject deserves, should I relate or particularly enumerate the peculiar Sensible and Medicinal properties, whereby the Salts are discriminated, which the several fore-mention'd Substances do afford. I shall therefore at present only suggest, what in my apprehension renders them so multifariously different from each other; and then discover, How they may be

reduced

reduced unto the ſame Common nature, and, if you pleaſe, being united, become an Uniform and Homogeneous Subſtance; wherein I may challenge the moſt ſevere Criticks and experienced Chymiſts, to find a greater variety of Parts and Qualities, than what is abſolutely neceſſary to conſtitute the Eſſence and Definition of a Volatil Salt in the abſtract.

It was long ſince by the famous *Van Helmont* judiciouſly obſerv'd, and by many Experiments confirmed, That variety of *Sulphurs* did chiefly diſcriminate the *Species* of Mixt bodies, and that moſt of the conſiderable changes, which were made in or upon them, were occaſion'd by ſeparating their own, or ſuperinducing an extraneous, Sulphur. If this be affirm'd of Sulphur, a pretended Simple Homogeneous body, and the ſecond Principle of the Chymiſts, it is denied: But if he intended, as is moſt probable, by *Sulphur* a ſubſtance, which, when ſeparated, is uſually inflammable, and doth ordinarily appear in an Oleaginous form, I eſteem his aſſertion very probable and ſpecious.

Let us make a ſhort reflexion on the Oyles extracted out of Vegetables by the aſſiſtance of Common water, which are as 'twere a Compendium of the Vegetables that afforded them, being eminently and manifeſtly enobled with moſt of thoſe ſenſible and thoſe more hidden Qualities that did determinate the Vegetables whilſt flouriſhing: Whereas their Salts, whether fixt or volatile, their Waters and Earths, can boaſt of little, which diſcovers whence they proceeded, unleſs they retain ſome ſmall portion of their reſpective *Oyles*, whoſe preſence occaſions thoſe ſlight differences, which diſcriminate them from each other, and being thereof deprived, they relapſe into their Elementary ſimplicity. The ſame happens, as with Fixed, ſo in Volatile, Salts, which are different ſo long as they retain any mixture of thoſe Oyles and Sulphurs, wherewith the Concrete that afforded them was imbued; from which being freed they all agree in one Common eſſence.

Although I could confirm this Poſition by a great number and variety of Experiments, I ſhall for the preſent acquieſce in ſome eaſie and obvious operations, which will ſufficiently manifeſt, that *all* Volatil Salts, being freed from adhering Oyles or Sulphurs, become forthwith Homogeneal and Uniform.

Take any Volatil Salt, whether Vegetable, Animal, or Mineral, put it into a very tall Glas-body or Bolthead; ſublime the Salt in Aſhes, B. M, in a Lamp-furnace, or with other equal temperat heat, the more remiſs the better. Repeat this Operation twice or thrice:

Most of the Oyl remains at the bottom, or adheres to the sides of the vessels employed; and the Salts will not easily be distinguish't from each other, agreeing in most, if not all, manifest qualities.

But, because this Operation will not so well succeed, unless the Vessels be very conveniently shaped, and the fire exactly regulated by a Judicious experienced Artist; for, either skill or due care being wanting, some small portion of the more subtile fugitive Oleaginous or Sulphureous particles will ascend with, and infect the Salts, which are thereby still in some measure (if I may so speak) specificated: I shall briefly represent a more certain and facile method of reducing them into one Common nature and denomination. Pour upon the Volatil Salt, you would purify, a convenient quantity of well-rectified Spirit of common Sea-salt. When the Salt is satiated, (which is discerned by ceasing of the heat, ebullition or commotion,) then with a gentle equal heat abstract the phlegme, and with it some small quantity of Volatil Salt, which not being closely united, is upon the first accession of heat presently dismissed. Sublime the remaining dry substance, which will become good Armoniac Salt. This being pulverised, and mixed with equal parts of a pure and well-calcined Alcalisate Salt, or if you pour thereon a strong *lixivium* or Solution of any perfect *Alcali*, the Alcalisate Salt combining more closely with the Acid than the Volatile; this latter will be elevated by a small degree of heat, and appears, either immediately, or upon rectification, in the form of a dry subtile fugitive Salt, perfectly free from the contagion of Oyles or Sulphurs. And by this Common method of procedure All volatil Salts, although the Tribes and Concrets that afforded them were exceeding different and distant, and they also disagreeing in Sensible, and (as they are commonly stiled) Occult qualities, are brought unto a perfect agreement in some few common properties.

I might add, that, whatsoever can be effected by Artificial operations, in order to the Un-specificating of Volatile Salts, is more naturally and speedily perform'd by the *Air* *, which is, as I could fully demonstrate, impregnated with a Volatil Salt, *partly* sublimed by Subterraneous, and extracted by Celestial, fires; *partly* expired from Animals during their life; and both from them and Vegetables upon the dissolution or dissociation of their constituent parts in Arefactions and Fermentations. These Salts, being received into the vast

* See Mr. *Boyle's* Tract of *Suspicions about some Latent Qualities in the Air*, lately printed, and come to my hands when I committed this Discourse to the Press: Of which Tract I should have given an Accompt in these Papers among other Books, but that it is accompanied with some other pieces, that are not yet quite printed off.

vaſt ſubtle fluid Expanſe, are immediately deveſted of their diſcriminating properties, and become the Inſtruments of ſundry remarkable effects and operations, not only in Natural, but alſo Artificial, productions: Which Salt may be obtain'd by ſundry methods, and out of ſeveral ſubſtances in its pure ſimplicity; but being once diſſolved in Rain, and Dews, and thereby inſinuated into the Earth, or otherwiſe caught and conveyed into Vegetables, they are ſoon ſpeciated, and by union with the other Principles or Corpuſcles of a different nature, do degenerate, or are exalted (which you pleaſe,) and of Simple (at leaſt comparatively) become Compound ſubſtances; yet eaſily again reducible, by Nature or Art, unto their primitive Simplicity.

Theſe are not Dreams of a delirous Chymiſt, but Poſitions, which I could confirm by an entire *Series* of Experiments; poſſibly hereafter to be communicated, if upon a ſtrict *examen* I find them worthy publiſhing in this Inquiſitive and Judicious Age.

It remains, that I ſhould detect the ſame Identity or Uniformity of nature and properties to reſide in all, highly rectified, *Vinous* Spi*rits*, which we have diſcover'd in Salts both fixt and volatil.

That *Vinous* ſpirits are only (or at leaſt chiefly) the more ſubtle fine Oyles of Vegetables, by fermentation broken into leſſer particles, and leſs branched than thoſe which conſtitute the Oyles themſelves, will appear highly probable to him, that ſhall duly conſider the Manner of their production, and ſeems demonſtrable by divers obvious Experiments. For, the ſame quantity of Vegetables, which being diſtilled with water, no fermentation preceding, yields Oyl plentifully, and little, if any, Vinous ſpirit; being diſtilled after a convenient time of Digeſtion, and the addition of ſome proper Ferment, they afford ſtore of Vinous ſpirits, and if fully fermented, there is little appearance of Oyl. Alſo the ſame Herb, fermented after its Oyl is extricated by the uſual method, yields a farr leſs proportion of Vinous ſpirits, than when fermented, before it was deprived of its Oyl. That portion of the Oyl, which is by the fermentation divided into leſſer particles, although, notwithſtanding this comminution, they are (according to the *Carteſian* Hypotheſis) branched enough to continue inflammable, yet being minute, do not affect the Palat after ſuch different manners, or make upon it ſuch a variety of impreſſions, as thoſe that are occaſioned by impulſes from the more groſs Oleaginous particles.

Now, if the ſmaller and more ſubtile matter, which we ſhall henceforth call *Vinous Spirits*, being preſs'd by heat, carry up and convey

convey along with them some entire unbroken Oily parts, or receive them that are capable of being elevated with the same degree of heat by which they were raised; these mixtures will retain somewhat of the most remarkable differences in Taste, and sometimes Odour, whereby the Vegetables themselves on their Oyls were discriminated: But upon long frequent Digestions, or reiterated Distillations, these gross Oleaginous particles are either subdivided, and thereby become Vinous spirits, or that gentle equal degree of heat, which is sufficient to elevate the more active volatil Vinous spirits, cannot raise the more sluggish Oyles; so that the Results are pure single homogeneous Vinous spirits, which, whatsoever the Concretes were from whence they were derived, though vastly differing from each other, as also their Oyls, out of which the Vinous spirits were more immediately produced; yet the Spirits themselves thus purified are in Outward appearance similar, and perhaps as perfectly simple and homogeneous, as most substances in the Universe.

What I have deliver'd, is further confirmed by a more visible palpable Conversion of Vegetable Oyles into Vinous Spirits; which I have effected in *many*, and, by Analogous operations, I presume, the same change may be superinduced upon *all*. Pour upon an ounce of some common vegetable Essential Oyl two or three pound of Vinous spirit perfectly dephlegmed; (the greater quantity, the more speedily is the transmutation or change performed:) The Spirit will immediately, upon simple agitation, absorbe, devour, or dissolve the Oyl, which by long digestion or reiterated cohobations may be totally devested of all those peculiar properties, it enjoyed whilst an Oyl, and become perfectly Vinous, never to be separated in a distinct form, or by any known *diacritical* sign or artifice, to be discriminated from what hath, in all appearance, converted or transmuted it into its own nature, or, at least, into a substance so like it self as to deserve the same denomination.

I shall here instead of a Conclusion impart unto you two very odd surprising Experiments, which have some, though remote, relation unto the preceding Discoveries concerning Alcalizate and Volatile Salts.

Having procured a great quantity of *Fern*-ashes, I extracted their Salt after the common method with water; most of the water being evaporated, I obtain'd several pounds of Salt, the greatest part whereof being first dried, I exposed the remainder unto the Air, that it might arrest some of the Vapors flitting in the same, and thereby

thereby became fluid; which is commonly, tho improperly, ſtiled an Oyl *per deliquium*. The reſt of the *lixivium* which continued fluid, being filtred whilſt warm, was of a very red colour, deeper than that of *florid* Blood, or of moſt Clarets, and exceeding ponderous: The *colour* argued it abounding with Sulphureous or Oily parts, and the *weight*, that it was highly ſatiated with the Saline. Having put this ſtrong Solution into a capacious glaſs, I either forgot or neglected it five or ſix weeks; and then looking after it, my Eyes were unexpectedly ſaluted with a moſt pleaſant ſpectacle, which having arreſted, did immediately fix, detain and employ them in the contemplation of an Object, which did at once moſt charmingly invite and fully requite their greateſt attention, The *Lixivium* had depoſited a large portion of the Salt it formerly contained, part of which ſubſided, I ſuppoſe, immediately upon its cooling; and, ſeveral weeks of very cold weather enſuing, did occaſion the Præcipitation of more: So that, according to my eſtimation, it was at leaſt 2 inches thick over the bottom of the Veſſel. The loweſt part of the Salt was of a dark colour, as if ſome earth, dirt, or dregs, were admixt therewith. The upper part or ſurface contiguous to the Liquor was exceeding white; and there did ariſe or ſpring out of the whole maſs of Salt, at ſmall diſtance from each other, ſeveral, I believe 40, branches, which, abating the colour, did moſt exactly reſemble that ſort of *Ferne* which is ſingle like *Polypody*, and not branched, ſending out ſeveral leaves on each ſide from one ſtem. Their magnitudes were divers, but the figures of all were the ſame, without the leaſt variation; only ſome emitted more leaves from the ſtem than others; which is alſo uſual in the Natural Fern. I preſerv'd theſe Artificial, regenerated or reſuſcitated Vegetables many weeks in the ſame poſition, not moving them, they being of ſo tender a fabrick, that the leaſt motion of the Glaſs did hazard their diſappearance. Several perſons were entertain'd with this admirable Phænomenon; and enquiry being made, before they were prepoſſeſſed with the foregoing Relation, what Herb they did apprehend this pretty Phantaſm repreſented, did unanimouſly refer it unto Fern. But this agreeable Scene ſoon vaniſhed; for, upon my return out of the Country, where I then reſided, unto *London*, although I had uſed all imaginable care and diligence to preſerve them in their priſtine beauty and integrity, by agitation during the Journey, or ſome other accident, theſe pretty appearances were reſolv'd into the confuſed Chaos out of which they were educed.

Obſ. 1.

Obſ. 1. The Fern was of a middle conſtitution between green and dry when burnt.

2. It was imployed to dry Malt burnt in a Kiln with a cloſe ſmothering heat.

3. Therefore the Aſhes yielded a far greater proportion of Salt, than when the Herb is very dry, and incinerated by a free open fire.

4. From the ſame cauſes the Salt was not perfectly Alcalizate, but plainly Tartareous, and abounded with Oyl and Acid particles; and therefore might properly enough be called an Eſſential Salt: And upon fuſion with a ſtrong fire was much changed, from a dark brown becoming white, and was by the action of the fire much leſſen'd in bulk, the conſequence of the avolation of Oyl, Acidities, and perhaps other Subſtances, during the operation of ſo ſtrong a fire.

5. That part of the impure Salt, which, as I before intimated, was ſet to deliquate, did not, as is uſual, become liquid, but a perfect gelly, which could not by any method be afterwards reduced unto its ſaline form: Which recals unto my mind what is deliver'd by *Kircher* of his own perſonal experience in the Reſuſcitation of Plants, who affirms, that at ſome certain time of the operation the prepared Vegetable Subſtances appear in ſuch a form.

The other Experiment concerning *Volatil* Salts ſucceeded after this manner;

Having occaſion for Volatil Urinous Spirits for ſome ordinary uſes, I mixt equal parts of Sal Armoniac and Pot-aſhes, which latter had a very ſtrong ſulphureous ſmell, yet did ſeem to abound with Salt, and that conſiderably Alcalized. The mixture being put into a tall Glaſs-body, immediately upon its feeling the heat, plenty of a Volatil Salt ſublimed, from which I expected no unuſual appearance, having often repeated this operation without obſerving any circumſtance which deſerv'd peculiar attention. Being called from my Laboratory by ſome Company or Employment juſt as the Salt began to appear, at my return I was amazed to ſee in the Glaſs-head, which was, as the Cucurbit, very ſpacious or capacious, a Foreſt in perſpective, ſo admirably delineated, as not to be excelled, if imitated, by the pencil of the greateſt Maſters in painting. They were all, not only to my apprehenſion, but alſo in the Opinion of ſeveral Spectators, ready to atteſt it, Shadows, Rudiments, Adumbrations, or Repreſentations of *Firrs*, *Pines*, and another ſort of Tree which I cannot eaſily deſcribe, nor have I ever ſeen it growing wild or in gardens, or in any Herbal exactly repreſented. All theſe Images, although very numerous

rous, very reducible to one of these *three* species. I do not remember, that I have ever seen any more transportingly agreeable Appearance in any Chymical operation, although it is well known, that Chymistry doth daily present those, who are very conversant with her, a great number and variety of objects, highly diverting for their prettiness and curiosity in colour, figure, and other accidents.

But to return unto the foremention'd Operation, I am not ignorant, that Volatil Salts do constantly shoot into variously and beautifully shaped Crystals, but I could never observe them regular, or reducible unto a certain number of figures; whereas in the Operation we have described, the figures were *first* very different from any that ever appear'd before or since upon Distillation of Commixture, and Distillation of Pot-ashes and Salt Armoniac, altho by me frequently repeated; as neither upon the Distillation or Rectification of Hartshorn, Blood, Urine, *Cranium humanum*, Salt Armoniac with Lime, Salt of Tartar, and other Alcalies. *Secondly*, The Figures were all reducible, in the apprehension of every Spectator, unto *three* kinds, two of them commonly known; and some of them were persons not easily bribed by fancy.

Howsoever, had I been considerate and well advised, I might have easily silenced doubt and detraction both, by preserving the Glass containing this beautiful Scene, which was prevented by my astonishment at, and too greedy contemplation of, so delicious a spectacle; whereof, to my great grief, I was soon deprived by the Sublimation of more Salt, which filling up the Interstices, did, together with the former, case the Glass, and retained no other Figure than the Concavity thereof allow'd of.

The next day that great Virtuoso, Sr. *Robert Moray*, (whose memory can never be too much cherished, nor his loss sufficiently bewailed,) honouring me with a visit, I acquainted him with the lately recited Accident; who scrupled not, though a rigid Philosopher, to credit my Relation, and to confirm me in the belief, that some certain governing principle might contribute towards the production of this *Phænomenon*. He affirm'd, that one *Davison*, a famous and experienced Chymist at *Paris*, had frequently shew'd him in a Glass a great company of *Firrs* and *Pines*, which seem'd no less lively and accurate, than those produced by Painters are; but such suspicions were soon stifled by their speedy disappearance and easie reproduction. He also referr'd me unto his Book of *Chymical Operations*, where I find he makes mention of it,

as a great artifice, as really it was, and makes it no leſs a myſtery by concealing the proceſs or manuals, whereby it may be effected; only, that nothing was emploied beſides ſubſtances afforded by the Trees which were repreſented; and that the chief Ingredient was Turpentine. Herein his operation differ'd from that which I lately recited; in that the ſubſtance, out of which he raiſed thoſe ſhapes, was of a more Fixed Nature; that which afforded mine, Volatil to the higheſt degree: *He* could conſtantly and regularly produce theſe Figures; but *mine* did unexpectedly and fortuitouſly repreſent themſelves unto my view; neither do I ever again expect the like appearance. Nor will I contend with *him*, that ſhall affirm, it was a mean Phantaſme, or a fortuitous Coalition of Salts into ſuch pretty figures. But that they were not really ſuch as I have related, the moſt Satyrical *Railleurs* or moſt obſtinate *Scepticks* ſhall never prevail upon me to recant and deny.

More Obſervations from Mr. Leewenhook, *in a Letter of* Sept. 7. 1674. *ſent to the Publiſher.*

I Took, (*ſaith he*) the *Eye* of a Cow, and having with a great pin pierced the *Cornea*, I found in the *Aqueous humor*, which I took out, ſome *few* cryſtallin globuls ſwimming. The dark-brown colour, which I ſaw in this Eye, did conſiſt of dark gray globuls.

The *Cryſtallin Humor*, which in hardneſs almoſt reſembles a Nutmeg preſerv'd, I have with a raſor cut aſunder, and obſerving it in parcels, I found it to be made up of orbicular Scaly parts, lying upon one another, which had their beginning out of the Center, and did all conſiſt of cryſtallin globuls.

After I had let this Cryſtallin humor dry for three dayes, it was grown ſo hard, that, when I put the knife to it, it burſt in pieces as if it had been hard roſin. Theſe pieces being by me view'd again, I not only found in them the aboveſaid orbicular Scaly ſubſtance, but alſo, that every ſcale was compoſed again of circular parts, and that theſe circles run contrary to the firſt; like to a Globe made up of paper, to the uppermoſt paper of which may reſemble the outermoſt ſcale or plate of this Cryſtallin ſubſtance; under which uppermoſt Superfice there lyes another ſcale, and ſo on continually unto the center of the globe: This I take to be like the firſt orbicular ſcaly ſubſtance, of which the Cryſtallin humor is made up. The other round ſubſtance, of which each ſcale is compoſed, I ſee, as if upon the mention'd Globe there were drawn lines cloſe by one another, the firſt thereof paſſing through both poles, and the others running along the ſides thereof, juſt as if the ſuperfice of the globe

were