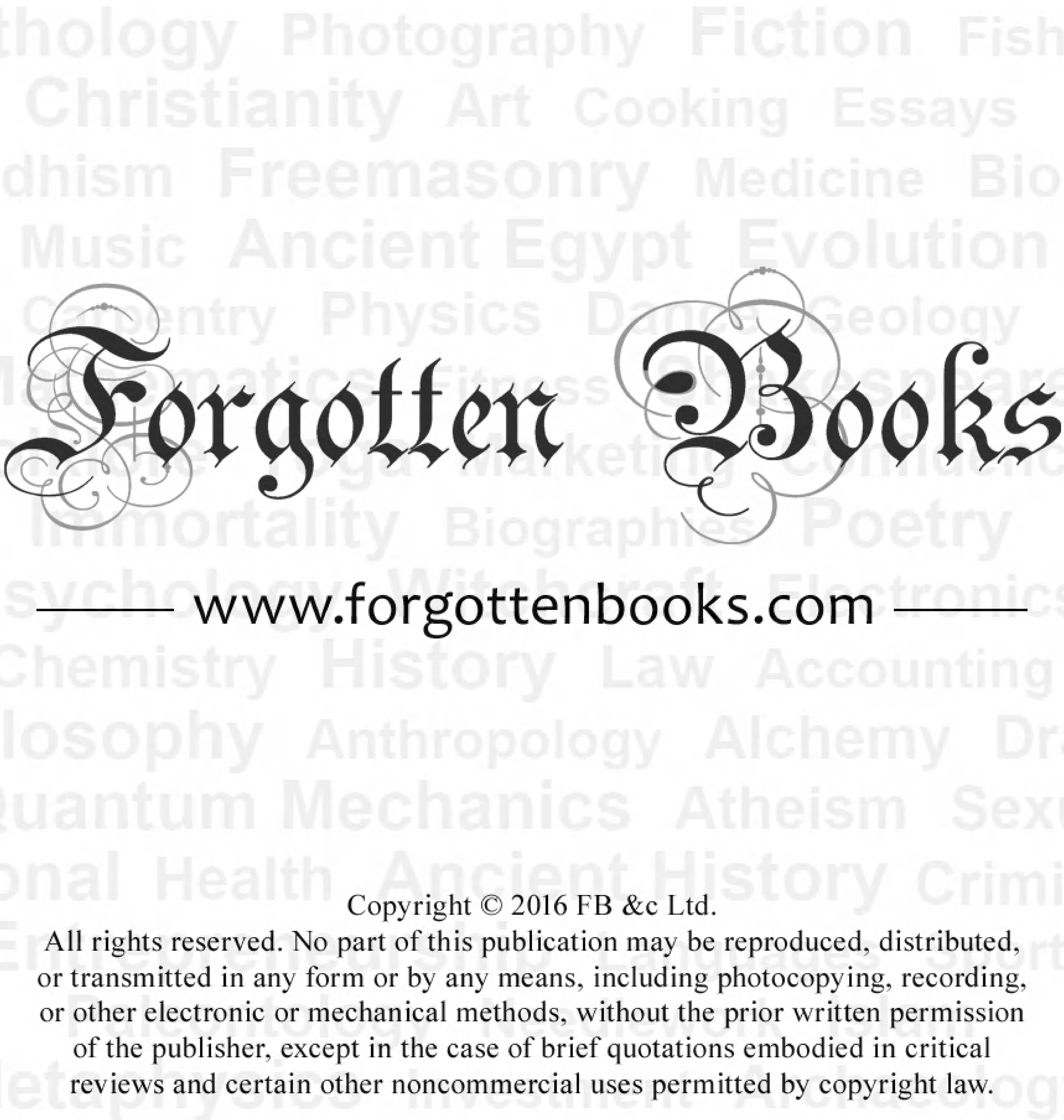

THE

Philoſophical Works

Of the HONOURABLE

ROBERT BOYLE Eſq;

Abridged, methodized, and diſpoſed under the

GENERAL HEADS

OF

PHYSICS,
STATICS,
PNEUMATICS,

} { NATURAL HISTORY,
CHYMISTRY, and
MEDICINE.

The whole illuſtrated with NOTES, containing the *Improvements* made in the ſeveral *Parts* of natural and experimental *Knowledge* ſince his time.

VOL. III.

By *PETER SHAW*, M. D.

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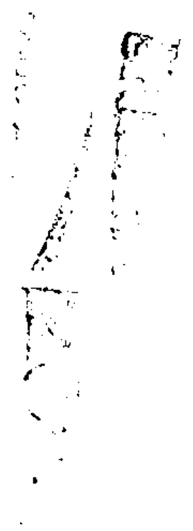

TO

The Right Honourable

The Lord *Shannon.*

MY LORD,

SUCH was the merit of the Honourable Mr. *Boyle*, ſuch his abilities and public ſpirit, that, perhaps, no man ever deſerved a greater, or bore a fairer character. The honour he reflects upon his noble family and your Lordſhip, is worthy of that he derives from thence. Never were a polite education and a philoſophical genius improved more to the advantage of mankind, to private ſatisfaction and true glory, than by the great Mr. *Boyle*; that noble example for the imitation of men of plentiful fortunes, and a philoſophical taſte, in laying out their lives to their own and the public

lic advantage. And whence can we with more juſtice expect, or whence more frequently ariſe, ſuch bright examples, than from your Lordſhip's noble family, which inherits the virtues that have rendered the name of Mr. *Boyle* ſo deſervedly famous?

The two former volumes of the abridgment of his incomparable philoſophical writings being put under the protection of competent judges; this third begs your Lordſhip's acceptance; that the whole may be ſubmitted to ſuch as know to ſet a juſt value upon philoſophical merit, and have a natural and tender regard for the original author.

I am,

May it pleaſe your Lordſhip,

Your Lordſhip's moſt humble,

moſt obedient,

And moſt devoted Servant,

Peter Shaw.

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NATURAL

HISTORY.

VOL. III.

THE PREFACE.

NAtural Hiſtory ſeems at preſent to lie under ſome Diſgrace, upon account of the ſmall Benefit that is preſumed to ariſe from the Study of it. And indeed, if a Notion be formed of the whole thereof, from a few of its Parts which have been dryly treated by ſome Virtuoſi, *a rigid Philoſopher might be apt to condemn it as trifling and almoſt uſeleſs to Mankind. A real philoſophic Genius, bent upon its own Improvement, ſees with Indignation, the Life of a* Virtuoſi *ſpent among Shells and Inſects; and wiſhes the ſame Time and Application laid out to nobler Purpoſes. Theſe Things however have their Uſe; and we ought not to deſpiſe all that we our ſelves have no Reliſh for. There will, and 'tis neceſſary there ſhould be Men of various Taſtes; and 'tis happy for the World that no Part of Philoſophy remains uncultivated. But if any Man has a deſpicable Opinion of Natural Hiſtory in general, let him look upon it in that View wherein Mr.* Boyle *conſidered it; for here, as in every Thing elſe, our excellent Author has regarded Uſefulneſs and the Benefit of Mankind. Natural Hiſtory, as managed by him, has no ſuperfluous Branches; Nothing that barely amuſes the Mind, without gratifying and delighting it; Nothing that entertains the Fancy, without being ſerviceable in Life; and his Hiſtory of the Air, his Way of examining the Freſhneſs of Water,* &c. *are eminent Inſtances of it. But Natural Hiſtory, in its Extent, be found to be a very large Field, that required a*

great Number of Hands to be employed in it; and therefore to render it as useful and complete as possible, he endeavoured to engage many of his Friends in the Study thereof. 'Twas his Custom to distribute all such large Undertakings under proper Heads, and so dispose of those Heads separately to Persons whom he respectively knew well qualified to cultivate and improve them. But he found few such diligent Searchers into Nature as Himself; and therefore received little Assistance this Way from his Friends. Hence several Parts of his Schemes of Titles remain unspoken to; and this is particularly the Case in the following History of the Air. Mr. Boyle, *however, performed Wonders of himself; his Inquisitive Genius led him to abundance of Particulars which escape the Knowledge of others; and these he generously communicates. Were this Practice encouraged, and were more Heads and Hands employed after the same Manner, the World might in time see what Mr.* Boyle *has here laid the Foundation of, A Complete Natural History; by Means whereof Philosophy it self would at length be completed also.*

HEADS

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

NAT. HIST. taſte, ſubterraneous paſſages, fruitfulneſs, &c. lakes, ponds, ſprings, and eſpecially mineral waters, their kinds, qualities, virtues, and how examined; the ſorts of fiſhes, their ſize and goodneſs, plenty, ſeaſons, ways of breeding, haunts, and the methods of taking them; eſpecially thoſe that are not purely mechanical.

The earth. In the Earth may be obſerved it ſelf, with its inhabitants and productions, as well internal as external; its dimenſions, ſituation, Eaſt, Weſt, South, or North; its figure, plains, hills or valleys; their extent, the height of the mountains, either in reſpect of the neighbouring valleys, or the level of the ſea; whether the mountains lie ſcattered, or in ridges; and whether thoſe run North or South, Eaſt or Weſt, &c. What promontories, fiery or ſmoaking hills, &c. the country has; whether ſubject to earthquakes or not. Whether the country is coherent, or much broken into iſlands. What declination the magnetick needle has in ſeveral places at the ſame time; and how much it varies in different times at the ſame place; whether before hurricanes, the needle loſes its direction towards the North; and turns equally to all the points of the compaſs. The nature of the ſoil, whether of clay, ſand, gravel, &c. its peculiar qualities and productions, as to minerals, vegetables and animals: And how all theſe are or may be farther improved for the benefit of man.

Inhabitants. Under Inhabitants are to be conſidered both the natives and the ſtrangers who have been long ſettled there; particularly as to their ſtature, ſhape, features, ſtrength, ingenuity, diet, inclinations and cuſtoms, that ſeem not due to education. In the women, their fruitfulneſs or barrenneſs, their eaſy and hard labour, with their exerciſes and diet; the diſeaſes, with their ſymptoms, and the diet, air, &c. that influence them.

Vegetables. The external productions are trees, fruits, plants, &c. with the peculiarities obſervable in them. In what ſoils, and with what culture they thrive beſt; with what animals or inſects the country abounds, and to what uſe applied by the inhabitants, as to food, phyſic, ſurgery, &c.

Minerals. By the internal productions of the earth, are here underſtood things generated in the bowels of it, either to the benefit or hurt of man. Under theſe are comprehended metals, minerals, ſtones, precious or common. To examine how the beds of them lie in reference to North or South, &c. What clays and earths are afforded, with their phyſical or other uſes; what coals, ſalt, or ſalt-ſprings, alum, vitriol, ſulphur, &c. The number of mines, their ſituation, depth, ſigns, waters, damps, quantities of ore; extraneous things, and ways of reducing their ores into metals, &c.

Traditions. Add to theſe the enquiries about traditions of all particular things relating to the country, ſuch as are either peculiar to it, or at leaſt uncommon elſewhere.

Enquiries

Enquiries that require learning or ſkill to anſwer; with propoſals for ways to enable men to give anſwers to ſuch more difficult enquiries. NAT. HIST.

To obſerve the declination of the compaſs in different longitudes and latitudes; ſetting down the method by which the obſervation was made. *Enquiries for the ſea.*

To obſerve the dipping-needle, in the like manner.

To obſerve the odour, colour, and taſte in ſea-water; the proportion of its ſalt in different places; whether in the ſame ſea it be conſtantly the ſame; and what are the particularities of that ſea-water, where ſhips cables ſooneſt rot, and where they are beſt preſerved.

To remark, if there be near the South pole a conſtant current, ſetting from the South ſo forcibly, that ſhips with a ſtiff gale can hardly make way againſt it; and near the North, a current forcibly carrying ſhips towards the pole; or if this motion reciprocate once in half a year.

To obſerve what ſubterraneous paſſages there are, whereby ſeas communicate with one another.

What effect the winds have upon the ſeas; and how far from the ſurface they agitate the waters.

The ebbings and flowings, with the age of the moon when the neap and ſpring-tides happen; to what height it ebbs and flows at theſe times upon the coaſt, or the iſlands far off in the ſea; and if it flow there differently from the tides near the main land; and how much ſooner it begins on one ſide than another.

To mark narrowly the way of coming into particular creeks and harbours; with their bearings and diſtances from the neighbouring places.

To ſound all along at coming in; and to mark the depths and ſhallows near the ſhore, or farther off from the coaſt, as alſo near ſhelves or banks.

To mark in the founding not only the depth, but all the grounds, whether clayie, ſandy or ouzy, *&c.* To mark whether the ſea always riſes towards the ſhore, unleſs accidentally hindered. How the bottom of the ſea differs from the ſurface of the earth; with the ſtones and minerals to be found there.

To take notice of the winds, their changes, or ſet times of blowing, and in what longitude and latitude, eſpecially the trade-winds; upon what coaſt the trade-winds are moſt frequent; and by what ſigns they may be foreſeen.

To obſerve and record all extraordinary meteors, lightnings, thunders, and their effects, *Ignes fatui*, comets, *&c.* marking the places of their appearing and diſappearing.

To examine the weights of the ſeveral waters that occur, both near the upper and lower part of the ſea; the power aſcribed to the ſea of throwing up Amber, ambergriſe, *&c.* and its ſhining in the night.

The

NAT. HIST.

Enquiries for mines.

The medicinal virtues of the Sea; eſpecially in the Hydrophobia. Its virtue to manure land; and to learn what plants thrive beſt with Sea-water.

Whether the country wherein the Mines are, be mountainous, plain, or diſtinguiſhed with valleys? And in caſe it be mountainous, what kind of hills are they, whether high, low, or indifferently elevated? Whether almoſt equal, or very unequal in height? Whether fruitful or barren; cold or temperate; rocky or not; hollow or ſolid? Whether they run in ridges, or ſeem confuſedly placed; and if the former, what way the ridges run, North or South, *&c.*? And whether they run nearly parallel to one another?

What the country produces, and what in moſt plenty?

What cattle it ſuſtains? Whether they have any thing peculiar in point of bigneſs, colour, longevity, fitneſs or unfitneſs for food, *&c.* which may rather be attributed to the peculiar nature of the place, than the barrenneſs of the ſoil, or other manifeſt cauſes?

What health the inhabitants enjoy; what diſeaſes they are ſubject to; and to what not? And what remedies are known for the epidemic diſeaſes of the place?

What plenty of rivers, brooks, lakes, ſprings, *&c.* in the place; the colour, taſte, *&c.* of them; and how they affect the health of ſuch as uſe them?

How the air is diſpoſed as to heat or cold, calms or winds; and whether theſe winds proceed from, or are infected with ſubterraneous ſteams? whether theſe ſteams are clear or foggy?

Whether the ſoil near the ſurface of the earth be ſtony; and if ſo, what ſort of ſtones it abounds with; whether the ſoil be clayie, marley, or chalky; and of how many kinds it is; and by what properties they are diſtinguiſhed?

By what ſigns a mine is conjectured to be in a place?

And as theſe ſigns are either above or beneath the ſurface of the earth; it muſt be farther enquired whether the ground be made barren by metaline or mineral effluvia?

What trees or plants grow moſt plentifully in theſe places, and whether they thrive well or ill? whether they be diſcoloured in their leaves, or have their outſides changed?

What alteration is produced in the waters of the place, either as to their colour, taſte, ſmell, weight; or what matter they leave upon the ſtones they run over?

Whether ſnow or ice continue as long in theſe, as in the neighbouring places?

Whether the dew that falls on the ground will diſcolour white linen? And whether the rain will diſcolour cloaths, or afford any reſidence of a mineral nature?

Whether thunder, lightnings, and ſtorms are frequent here? And if there be any fiery meteors and nocturnal lights?

Whether

Whether miſts ariſe from ſuch mineral grounds; what is obſervable in them; what minerals they ſignifie, and may be ſuppos'd to be produc'd by? NAT. HIST.

Whether the *Virgula divinatoria* be us'd for finding out the mines, and with what ſucceſs?

Whether there be any clays, marles, or other mineral earths, and of what conſiſtence, that give notice of the ores; and at what depth they lie, in reſpect of one another, and how thick they are?

What ſtones, marcaſites, *&c.* are found near the ſurface; what is the particular ſhape, bigneſs, colour and weight of ſuch ſtones, whereby they are diſtinguiſhable from others?

Whether heat or damps ſignify a mine?

Whether water found in digging be a ſign of a mine?

By what ſigns the nearneſs of a mine is known; and whether any ſign will ſhew a perſon to be above, beneath, or on the ſide of the mine?

By what ſigns the determinate kinds of metals are known, with their plenty and goodneſs.

What ſigns there are of the depth of the vein; of the mine's being hopeleſs, or that 'tis unlikely to find a vein in the place 'tis digged for?

What is the depth of the ſhaft or groove, till you come at the vein or ore; whether the vein run or lie horizontally; or if it dip, what inclination it hath; and how deep the loweſt part lies?

What are its flexures, or whether it runs directly north or ſouth, eaſt or weſt, or ſeem rather to have a caſual tendency than any natural determination; and how far it reaches in all?

What is the wideneſs of the groove at the top and elſewhere; whether it be perpendicular or crooked; and if crooked, after what manner, and with what diſtance it winds?

How the groove is ſupported; what the kinds, length, bigneſs, and way of placing of the timber, poles, *&c.* employ'd to ſupport it; and how long the wood continues, without being ſpoil'd by the ſubterraneous fumes and waters; and what wood laſts the longeſt?

What air-ſhaft belongs to the mine; whether it be ſingle or double, of what breadth at the orifice; whether it be convenient or not; how near 'tis plac'd to the groove, and in what poſition; if there be ſeveral air-ſhafts, what their diſtances and ſituation with regard to the groove, and to each other; and how is air ſupply'd, if there be no air-ſhafts?

Whether they meet with waters, and what plenty there is of them; at what depth they are found; how qualified, and what way they ſpring, *&c.*?

Whether they are conſtant or temporary; whether they increaſe or diminiſh in the ſummer, or at any time of the year; and what that ſeaſon is, how long it laſts, and the proportions of increaſe and decreaſe?

What engines or contrivances are uſed for drawing up the water, and conveying it away; the materials they are made of, the parts, the bigneſs, the coaptation, and whole ſtructure, and way of applying the inſtruments uſed to free the mines from the water?

NAT. HIST.

What are the conditions, number, *&c.* of the adits?

Whether the mines be troubled with damps, and of what kind they are; whether they come often or ſeldom, at any Time of the year, or irregularly?

What ſigns precede them; what miſchief they do; what remedies are the moſt ſucceſsfully employed againſt them, as well in reference to the clearing of the mine, as to the preſervation and recovery of the men?

What methods the mine-men uſe in following the vein, and tracing their paſſages under ground, according to the ſeveral exigencies; and whether they employ the inſtruments made with the help of the load-ſtone, the ſame way that is uſual; and, if not, wherein they differ in the uſe of the ſame inſtruments, or what they ſubſtitute in their place?

By what means they ſecure themſelves againſt the uncertainty whereto the magnetical needle is ſubject, when it comes near iron ore; and what other means may be uſed, beſides a load-ſtone, to help a miner?

How the miners deal with the rock and ſpar they meet with, before they come at the ore; and how they uſe fire to ſoften, calcine, or crack them, and with what ſucceſs?

By what means they free the mines and the workmen from the inconveniencies ariſing from the great uſe of fire?

With what inſtruments they break the rock; how they are conducive, and how long they laſt?

How the miners work, whether cloathed or naked; what lights they uſe; what materials they are made of; and what meaſure of illumination they afford; how long they laſt, and by what ways they are kept burning in that thick and foggy air?

How veins are followed, loſt, and recover'd; and how ſeveral miners work on the ſame vein; and what is the beſt way of getting all the ore in a vein, and that moſt conveniently?

How they convey out their ore, and other things that are to be carried up; what kind of veſſels they uſe for matter, ſhape and capacity, and whether the workmen deliver them one to another, or the ſame workmen carry them all the way; and whether they deſcend and aſcend by ladders of wood or ropes, *&c?*

Whether the ore runs in a vein, or lies diſpers'd, or be divided partly into a vein, partly into looſe maſſes, or like a wall between two rocks, as it were in a cleft; or be interſpers'd in the firm rock, like ſpeckled marble; or be found in grains, like ſand or gravel; and what is obſervable in it as to weight, colour, mixture, *&c?*

Whether any part of the metal be found in the mine perfect and complete?

Whether the mine affords any parcels of metal that ſeem to grow like plants?

Whether the vein lie near the ſurface of the earth, and at what depth; whether it have any peculiar concomitants or coats; and

if any, what they are, and in what order they lie? Thus the veins of lead ore with us have frequently annexed to them a ſubſtance called ſpar, and next to that another call'd calk; and whether they have any other heterogeneous ſubſtance? NAT. HIST.

What are the principal qualities of theſe extraneous ſubſtances?

Whether the vein be inclos'd every way in its coats, or lie only between them?

Whether the vein be every way of an uniform breadth and thickneſs; and if it be, what the dimenſions are; and if not, in what places it varies, and by what meaſures?

Whether the vein be uninterrupted, or in ſome places broken off; whether abruptly or not; and whether by vales, brooks or gullets, *&c?*

How wide the interruptions are; by what ſigns the veins may be found again; whether the farther diviſion of the vein be of the ſame nature, and hold on in the ſame courſe, as to its tendency upwards and downwards, or horizontally, northward or ſouthward, *&c.* with the vein from which 'tis cut off?

Whether, in caſe the laſt end of the vein be found, it terminate abruptly, or in ſome kind of rock or earth, which, as it were, cloſes it up, without leaving any crack, or otherwiſe; whether the terminating part of the vein tends either upwards or downwards, or neither; whether in the places where the vein is interrupted, there be any peculiar ſtone or earth that ſeals up the extremity of it?

Whether it be obſerv'd that the ore, in tract of time, may afford any gold or ſilver, which it affords not, or more than it would afford, if it were not ſo ripe; and whether it has been found that the metalline part of the vein grows ſo, that ſome part of the ore will afford metal in tract of time, that did not ſo before; and whether to this maturation of the mine, the being expoſed to the free air be neceſſary; or whether, at leaſt, it conduce to the acceleration of it, or otherwiſe?

Whether all the ore contain'd in the mine be of the ſame nature and goodneſs; and if not, what are the differing kinds, and how to be diſtinguiſh'd and eſtimated?

What is the fineneſs and the goodneſs of the ore, by which the mine is uſually eſtimated; and what the marks and characters that diſtinguiſh one ſort from another?

What proportion of metal the ore affords?

Whether the ore be pure, in its kind, from other metals; and if not, of what metals it participates, and in what proportion?

What previous operations are us'd to the melting of the ore, as beating, grinding, waſhing, *&c.* and with what circumſtances; as how long the ignition laſts at a time; whether the ore be ſuffer'd to cool of it ſelf, or be quenched; whether it be waſh'd betwixt each ignition; or whether the ore requires no ſuch preparations, as it often happens in lead, and ſometimes in iron?

NAT. HIST.

Whether mercury is made uſe of in ſeparating the nobler from the baſer metals?

Whether the ore be expos'd to the air, as a preparative?

What flux-powders they uſe to examine their ores in ſmall quantities?

Whether in reducing or melting great quantities they uſe any flux-powder; what it is, and how employed?

What is the contrivance of the furnaces, and if they be all of one, or of differing ſorts or bigneſs?

What tools are uſed in ſmelting, and how contriv'd?

What fewel they uſe, and how much is ſpent in a day; and what returns they have of metal, in a proportionate time?

Whether the ore be melted by means of a wind, made by the fire's own motion, by water, or by bellows; if the latter, what their dimenſions are, and what way us'd?

What way they take to let out the metal that is in fuſion, to caſt it into bars, ſows, pigs, *&c.* and what clay, ſand, or mould they let it run through; and after what manner they cool it?

Whether to facilitate the fuſion, they mix ſeveral ores of the ſame ſort together?

Whether after 'tis once melted, they melt it again, to make it more pure; and if ſo, with what circumſtances they perform it?

Whether they have ſigns to know when the fuſion is well or ill perform'd; and that the metal has obtain'd a perfection requiſite in ſuch a fuſion, and ſuch a furnace?

Whether they obſerve any difference in the goodneſs of the metal that comes firſt, from that which comes laſt; and whether the rule holds conſtantly?

Whether the produc'd metal be all of the ſame goodneſs; and if ſo, how good it is compared with the metals of other mines, or other parts of the ſame vein; and if it be not, what differences are between the produced portions of metal, and what diſparity that makes in the price?

What are the ways of diſtinguiſhing them, and eſtimating their goodneſs?

Whether flowers be not elevated to the upper parts of the chimney; and whether they are barely excrementitious or metalline?

Whether, when the ores are brought to fuſion; they have any recrements; what theſe recrements are, and how to be ſeparated from the baſer metal?

Whether, after the metal has been melted, the remaining part of the the ore will, in tract of time, be impregnated with more metal?

Whether the air appears really to be cool in ſummer, and hot in winter, at the bottom of the mine, by more evident proofs than the teſtimony of our touch?

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Continue

NAT. HIST.

Whether the purgative virtue of cathartics be increaſed, diminiſhed, or even totally deſtroyed by a ſtrong continual cold?

Whether harts-horn, and the like ſubſtances thawed, will yield the ſame quantity of ſpirits as they do when they have not been frozen?

What are the effects of cold in the fermentations of liquors?

Whether birds and wild beaſts grow white in the winter-time, and recover their native colour in ſummer?

Whether colours may be concentred by cold; for inſtance, that of a ſtrong decoction of cochineal in a fit glaſs?

Whether the electrical virtue of amber, and the attractive force of the magnet, will be changed by vehement cold?

Whether thick pieces of iron and ſteel be made brittle by intenſe froſts; ſo that ſmiths are obliged, for prevention, to give their tools a ſofter temper?

Whether accurate obſervations ſhew, that all fiſhes die in frozen waters, if the ice be not broken; or whether the cold it ſelf, or the want of changing or ventilating the water, or the privation of air, be the cauſe of their death?

Whether any ſkilful anatomiſt has enquired, by freezing ſome animals to death, after what manner it is that intenſe cold kills men; whether they have found ice in the inward parts, as the brain and heart, and in the large veſſels?

MEMOIRS

MEMOIRS

FOR A

GENERAL HISTORY

OF THE

AIR.

Heads for a general history of the air.

1. *THE conſtant ingredients of the air, or atmoſphere.*
2. *The æther in the atmoſphere.*
3. *The elaſtic particles of the air and its ſpring.*
4. *The magnetic particles of the air.*
5. *The deſtruction, generation, abſorption, and extrication of the air.*
6. *The accidental ingredients of the air.*
7. *The aqueous particles in the air, with the moiſture and dryneſs thereof.*
8. *Clouds, miſts, and fogs.*
9. *Terreſtrial ſtreams in the air.*
10. *Salts in the air.*
11. *Sulphur; inflammable particles in the air; lightning and its effects.*
12. *Celeſtial influences or effluvia in the air.*
13. *The height of the atmoſphere.*
14. *The motion of the air; and winds.*
15. *The air conſider'd as the medium of ſounds. Noiſes in the air, and particularly thunder. The air's operation on the ſounds of bodies.*
16. *The weight of the air.*
17. *The conſiſtence of the air; its rarity, denſity, fluidity, and ſubtilty.*

18. *The*

18. *The heat and coldneſs of the air.*
19. *The air conſider'd in relation to light; its perſpicuity, opacity, reflexions, refractions, colours,* &c.
20. *The operation of the air on the conſiſtence of animal, vegetable and mineral ſubſtances.*
21. *Air conſider'd with regard to fire and flame.*
22. *Air, as it regards fermentation.*
23. *Air conſider'd as the receptacle of odours.*
24. *The air's operation on the odours of animal, vegetable and mineral ſubſtances.*
25. *The operation of the air on the taſtes of animal, vegetable and mineral ſubſtances.*
26. *The operations of the air on the colours of animal, vegetable and mineral ſubſtances.*
27. *The air conſidered as deſtroying or introducing leſs obvious qualities into animal, vegetable and mineral bodies.*
28. *Air conſider'd with regard to the propagation and vegetation of plants.*
29. *The air conſider'd with the regard to the generation, life and health of animals.*
30. *Heavy bodies ſuſtain'd by, or taken up into the air.*
31. *Dew.*
32. *Rain.*
33. *Hail.*
34. *Snow.*
35. *Unuſual things falling out of the air.*
36. *Miſcellaneous experiments and obſervations on the air.*
37. Deſiderata *in the hiſtory of the air; with propoſals to ſupply them.*

NAT. HIST. *Definition of the air.*

AIR here ſignifies the thin, tranſparent, compreſſible and dilatable fluid, wherein we breathe and move, that ſurrounds the whole ſurface of the earth to a conſiderable height, and differs from the æther in refracting the rays of the celeſtial luminaries.

The air may be conſidered both as tranſient and permanent. For example, if an æolipile of water be ſufficiently heated, and ſuffer'd to expel the particles of air by its aqueous vapour, this will afterwards be forcibly driven out in a large quantity, like the blaſt of a pair of bellows, and occaſion a ſharp, whiſtling noiſe againſt the edge of a knife conveniently held thereto. Yet ſuch a vapour, tho', whilſt the motion laſts, it reſembles air, ſoon loſes that reſemblance, eſpecially in the cold, and returns, by condenſation, to its original water.

Many are the experiments I have made upon the air, but farther trials appear neceſſary to determine its nature. I conjecture, however, that the atmoſpherical air conſiſts of three different kinds of corpuſcles; the

the first, those numberless particles which, in the form of vapours or dry exhalations, ascend from the earth, water, minerals, vegetables, animals, &c. in a word, whatever substances are elevated by the celestial or subterraneal heat, and thence diffused into the atmosphere. The second may be yet more subtile, and consist of those exceedingly minute atoms, the magnetical effluvia of the earth, with other innumerable particles sent out from the bodies of the celestial luminaries, and causing, by their impulse, the idea of light in us. The third sort is its characteristic and essential property, I mean permanently elastic parts. Various hypotheses may be framed relating to the structure of these latter particles of the air. They might be resembled to the springs of watches, coil'd up and endeavouring to restore themselves; to wool, which being compressed, has an elastic force; to slender wires of different substances, consistences, lengths and thickness; in greater curls or less, near to, or remoter from each other, &c. yet all continuing springy, expansible and compressible. Lastly, they may also be compared to the thin shavings of different kinds of wood, various in their lengths, breadth and thickness. And this perhaps will seem the most eligible hypothesis; because it, in some measure, illustrates the production of the elastic particles we are considering. For no art or curious instruments are required to make these shavings, whose curls are in no wise uniform, but seemingly casual; and what is more remarkable, bodies that before seem'd unelastic, as beams and blocks, will afford them. Hence also we may perhaps fetch an illustration of some experiments, wherein I found that various, solid, and mineral bodies, unsuspected of elasticity, being plunged in corrosive unelastical menstrua, will, upon a proper comminution of their parts, afford in the conflict a considerable quantity of permanently elastic air. But many other figures, and some perhaps more proper, may be attributed to these elastic corpuscles.

Nat. Hist. *Ingredients of the air.*

All I shall add is, that tho' air seem to continue elastic, upon account of its structure, rather than any external agitation, yet heat, which is a kind of motion, may make the agitated particles endeavour to recede from the centres of their motion, and to repel those that would hinder their free rotations; and thus greatly add to the attempt it makes towards expansion. And by this means there may perhaps be mixed with the springy particles, others whose elasticity is owing more to their motion than their structure; that variously whirling them, so as to remove the adjacent corpuscles, and thereby promote an expansive force in the air they go to compose. Some of these indeed, may, in very cold climates and seasons, prove of a like kind with what I above shew'd to be of a short duration; yet others of them may be so minute, agile, and advantageously shaped, that at least, in our climate, the air will be warm enough to promote its own agitation, and keep it self fluid,

NAT. HIST. and give a competent motion to particles so well disposed to preserve it.

The spring of the air.

" We find that in blowing up a football the included air gradually " increases in its resistance, and not only thus opposes its own conden- " sation, but also endeavours to expand it self. Whence we are furnish- " ed with a method of making fountains to play, and of shooting off bul- " lets by the spring of the included air. But because 'tis difficult to com- " press air to any considerable degree with the natural strength, 'twill " be proper to apply the skrew to that office, in the following manner.

Figure 1.

" Suppose for a fountain, the metalline vessel ABE, made concave at the " top, with a hole A, for the water to enter at; which, running in, will " force out the air thro' the open tube CD. Before the vessel is fil- " led, let the hole A, be close stopped with a skrew, and turn the stop- " cock, E, to close that end. Place next a little bucket on one side within " the vessel, with its embolus HI, whose upper part must be fixed to " the moveable ear of the vessel. The embolus HK, being perforated " quite thro', should have a valve fix'd to it at the hole S, to hinder " the air, there sent out, from returning; and the like is to be done " externally at the bottom of the bucket, I. Let the cylindrical sur- " face of the embolus be cut into a male skrew, and fitted to a female " one in the plate MN, which may be fastened externally as a prop " to the ear of the vessel, by means of two small skrews in M, and N. " When the water is in, these small skrews M, and N, are to be " loosened, and the plate to be raised from the vessel up to the han- " dle HO; whereby the embolus being drawn out, the air passes thro' " the perforation HS, to fill the bucket; and upon thrusting the embo- " lus down the valve at S, is shut, and the air forced out at the bucket " thro' the valve I, into the vessel, whence it can neither escape nor " force out the water; both the stop-cock and hole at A, being shut; " consequently it is condensed; and at a second elevation of the em- " bolus endeavouring to expand it self, the valve I, is thereby forci- " bly pressed against the hole in the bucket, and that passage block- " ed up. When, by repeated strokes, so much air is forced in, as " causes the embolus to go very stiff, the plate MN, is again to be skrew- " ed on; and the pump may be further work'd, by taking hold of the " handle in O, and gradually revolving the embolus backwards and " forwards, by means of its skrews, till the air is very strongly compres- " sed, when opening the stop-cock E, the water will fly out at the " tube CD, at first with great vehemence, but less forcibly by de- " grees, as the elasticity of the air grows less. The like contrivance " will, also, proportionably serve in wind-guns, which may also be made " without any thing to receive the compressed air, after the manner " of the Elder pot-guns, used by children, with their paper pellets. " For a long concave cylindar of iron being procured, two leaden bul- " lets, by means of paper, or the like, may be exactly fitted to its " bore; so that if a female skrew were cut on the internal surface of

" one

" one end, whereto the male skrew cut on a ſolid cylindar of the ſame metal anſwered, which being a little ſhorter in length, and " made to move in the other by a force applyed to a proper han- " dle, till all the air contained in the cavity was condenſed into a " narrow compaſs between the two bullets, the foremoſt of them " would be thereby thrown out of the tube with a prodigious force." NAT. HIST.

Caſatus.

We put ſome copper filings, with a mercurial gage, into a conical cryſtal-glaſs, exactly fitted with a ground ſtopple, and poured upon the filings as much rectified ſpirit of fermented urine as roſe an inch above them; then carefully ſtopping the glaſs, we ſeveral hours after perceived that the mercury in the ſealed leg was conſiderably depreſſed; when letting in the external air, we found it to have a manifeſt effect upon the mercury. *Experiment* 1.

Into a like glaſs we put more copper filings, and poured thereon ſtrong ſpirit of putrefied urine, till it roſe about an inch above them, and having let down a mercurial gage, ſo that it reſted againſt the bottom and ſide of the glaſs, we cloſed it with a ſtopple, and ſet it in a quiet and well illumin'd place; having firſt obſerv'd the ſtation of the quickſilver in the gage. The menſtruum work'd very calmly upon the filings, gradually acquiring a very pleaſant blue colour; and the glaſs being kept at reſt in the ſame place for two or three days longer, the liquor began to loſe its colour, growing fainter by degrees, till at the end of three or four days it became very pale. Then admitting the external air, and leaving the vial in the ſame place and poſture, I found within four or five minutes the upper part of the liquor of a fine blue colour, which in ten minutes time had diffuſed it ſelf thro' the whole; ſo that in leſs than a quarter of an hour, the liquor was throughout of a rich blue colour, and in a few minutes longer grew opake. When carefully cloſing the vial again, we ſet it in the ſame place, where the liquor began again, within two or three days, to loſe its colour; ſo that I made a ſecond experiment much like the former. The like ſucceſs I had in a trial or two made in another glaſs, and once, with ſucceſs, about nine a-clock at night. In moſt of theſe experiments I forbore to ſhake the glaſs, leſt that ſhou'd be ſuſpected to raiſe ſome fine powder that might be precipitated out of the tincture, tho' I never perceived any ſuch. But if by the agitation of the liquor more parts of it were expoſed to the action of the air, the colouration would be haſtened. *Experiment* 2.

Having covered the bottom of a conical glaſs with filings of good copper, we poured ſtrong ſpirit of Sal armoniac upon them, till it roſe about a finger's breadth above them; and having let down a mercurial gage, ſo that it reſted againſt the bottom and ſide of the glaſs, we cloſed it very well with the ſtopple, and ſet it in a quiet well enlightened place, obſerving where the quickſilver reſted in the gage. The menſtruum work'd ſlowly on the filings, without producing any *Experiment* 3.

NAT. HIST. noiſe or ſenſible bubbles; gradually acquiring a very pleaſant blue colour. We perceived alſo from time to time, that for two or three days together, the mercury in the ſealed leg of the gage very ſlowly deſcended, till it appeared near a quarter of an inch lower than at firſt. The event of the experiment ſeemed ſufficiently to argue, that the ſpring of the air, contain'd in the cavity of the glaſs, communicating with that in the open leg of the gage, was weakened in comparison of that of the cloſed leg; which by the hermetic ſeal on one ſide, and the quickſilver on the other, was kept from ſuch communication. I further obſerved, that the depreſſure continued at different times of the day; tho' at noon the ſun ſhone hot upon the place and veſſels. This experiment was made four or five times, but not always with equal, yet with ſome ſucceſs; the mercury in the ſealed leg of the gage being ſometimes more and ſometimes leſs, but always manifeſtly depreſſed; which phenomenon was confirmed by the obſervation we more than once made of the ſudden return of the mercury to its former ſtation, upon unſtopping the glaſs, to give free admiſſion to the external air.

Experiment 4. A mercurial gage being put into a conical glaſs, the bottom whereof was covered with beaten coral, we poured thereon ſome ſpirit of vinegar, and cloſing the neck exactly, obſerved many bubbles were for a long time produced, which ſucceſſively broke into the cavity of the veſſel, whereby they compreſſed the air in the cloſe leg of the gage into about a third part of its former dimenſions. But ſome hours after the corroſion had ceaſed, the compreſſion made by this new air grew manifeſtly fainter, and the air impriſon'd in the gage drove down the mercury again to within about one diviſion of its firſt ſtation; where it continued for five or ſix days. So that there here ſeems to have been a double compreſſive power exerciſed; the one tranſient, by the brisk agitation of the vapours or exhalations, and the other durable, from the aerial and elaſtic particles, either produced or extricated by the action of the ſpirit upon the coral.

Experiment 5. A conſiderable quantity of ſpirit of vinegar being put upon minium in a conical glaſs, furniſhed with a glaſs ſtopple and a mercurial gage, no ſenſible depreſſure of the mercury appeared in either leg for ſeveral days; nor did any change happen in the gage upon removing the ſtopple, tho' it was evident by the great ſweetneſs acquired, that a large proportion of the minium was diſſolved.

Experiment 6. Into a round eight ounce vial we put ſome copper filings and a mercurial gage, pouring ſtrong ſpirit of Sal armoniac on the metal, till it reach'd to a conſiderable height in the vial, which being hermetically ſealed, was ſet in a ſouth window, where the liquor ſoon acquired a deep blue tincture, which in twelve days time grew gradually pale, till at length it appeared like water. During this, the mercury in the open leg ſeem'd to be impell'd up, and at about nine a clock at night we broke off the hermetic ſeal, upon which a noiſe was immediately pro-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

NAT. HIST. the atmoſphere, before 'twas thus employ'd. We removed the whole into a cooler room, where I found, the next day, no ſenſible alteration in the gage; and thus it continued for three or four days; but coming afterwards to look upon it, the mercury had aſcended about an inch and a half; and near the ſame quantity of water had got into the ſealed leg of the gage. But this was, very probably, owing to a careleſs removal of the tube that had been made, without my knowledge; for I have found no other remarkable alteration herein ſince the experiment was firſt undertaken, which is now eight or nine days; the mercury in the open leg ſtill remaining at about the height of an inch and half.

Experiment 2. I filled a pint vial with wheat-flower well drenched in water, ſtopping up the orifice both with cork and cement, and ſet it in a warm place of the laboratory, in a cold ſeaſon; where it continued for thirteen days, when it burns by the dilation of the included matter, which was, the night before, obſerved to have left a conſiderable vacancy below the cork. The matter to me taſted ſouriſh, but to another acid.

Experiment 3. We ſet a convenient quantity of bruiſed raiſins to ferment with water, in a bolt-head, including alſo a mercurial gage therein; when exhauſting the air, and preventing any from returning into the veſſel, 'twas placed in the warm laboratory. No ſpringy ſubſtance appear'd to be hence generated in four days, tho' the liquor, it ſeems, afterwards fermented more violently than the cold ſeaſon might be thought to allow of; for being not carefully looked to, the middle part of the glaſs broke to immenſly ſmall pieces, with a report equal to that of a piſtol; whilſt the bottom and neck remain'd tolerably entire.

Experiment 4. I fill'd a wide-mouth'd three pint glaſs, with a proper quantity of water and bruiſed raiſins. Upon the mouth of the glaſs we tied a large bladder by the neck, but firſt carefully freed from air, and faſten'd it well thereto with cement, to prevent any air from paſſing either in or out. In this condition we left the glaſs in the laboratory for fourteen days, when finding the bladder tumid, we ſhould have tied up the contain'd air therein, but for a ſmall hole there chanced to be in it. We therefore took it off, and cauſed a very limber one, capable of holding a quart of water, to be fix'd on in the ſame manner, and found it next morning ſo full of air, that we could not, without difficulty, and the loſs of a conſiderable quantity, tie up the bladder near its neck. Another bladder was afterwards applied as the former, which next morning appear'd full, as if diſtended by means of a pair of bellows.

Experiment 5. In the bottom of a wide-mouth'd vial we lodged ſome good ſpirit of ſalt, and the filings of ſteel, covering all with a receiver, fitted with an eel-ſkin, and a wire, whereto a thin and ſlender glaſs, hermetically ſeal'd at the bottom, was fixed, containing ſome filings of copper. The receiver being well exhauſted, we broke this glaſs of copper filings againſt the bottom of the vial, and let them fall into the menſtruum, whence enſued great ſtore of bubbles, which raiſed a froth much deeper

than

than the liquor; and the ſucceſſive generation hereof continued for a conſiderable time; ſome of them appearing large, tho' in the open air they would, perhaps, have been inviſible. The vial thus kept *in vacuo* for a quarter of an hour longer, and no greenneſs appearing in the liquor, the receiver was taken off. NAT. HIST.

A bubble of air, equal in diameter to a middle-ſized pea, being left at the top of a round vial, with a long and ſlender neck, and containing fine oil of turpentine, this was inverted into another vial of the ſame liquor, and ſuffer'd to ſtand in a quiet place for a competent time. The like was alſo done with ſpirit of wine at the ſame time. The event was, that in ſix days the bubble diſappear'd in the glaſs of oil of turpentine, and likewiſe in that of the ſpirit of wine the day following. *Experiment* 6.

Upon opening an exhauſted receiver, wherein was an unſtop'd vial above half full of an opake blackiſh liquor, ſuppoſed to have been frogs ſpawn, that had certainly been included for three years, we found by the gage put up with it, that it had yielded a little air. Its ſcent was fetid, like that of the pump of a ſhip, but it had produced no inſects, nor was turn'd mouldy. *Experiment* 7.

An induſtrious gentleman of my acquaintance, who digs for mines, and owns a good one, informs me; that when the miners meet with running water under ground, they are thereby ſupplied with air ſufficient for free reſpiration, even at the depth of many fathoms; but ſtagnant water, he ſaid, would not do the like. Tho' in his opinion, that air proceeded rather from the water it ſelf, than from its motion. *Obſervation.*

Experiments about the production of air, and the examination of it, propoſed.

1. To produce air by fermentation in well cloſed receivers.
   To produce air by fermentation in ſeal'd glaſſes.
   To ſeparate air from liquors by boiling.
   To ſeparate air from liquors by the air pump.
   To produce air by corroſion, eſpecially with ſpirit of vinegar.
   To ſeparate air by animal and ſulphureous diſſolvents.
   To obtain air in an exhauſted receiver by burning glaſſes, and red-hot irons.
   To produce air out of gunpowder, and other nitrous bodies.
2. To examine the produced aerial ſubſtances, by their preſerving or reviving animals, flame, fire, the light of rotten wood, and of fiſh.
   To examine it by its elaſticity, and the duration thereof.
   To do the ſame by its weight, and its elevating the fumes of liquors.

The dryneſs and moiſture of the air.

I am not ſollicitous that all the phenomena refer'd to the moiſture of the air, be ſolely produced by the bare moiſture thereof; 'tis ſufficient if this quality is the moſt obvious one; tho' other corpuſcles whereto moiſture ſerves as a vehicle, be alſo concern'd herein.

Dryneſs, as privative as its nature ſeems, may have a conſiderable ſhare in producing a change in bodies, and that in differing reſpects; the two principal whereof are theſe.

First,

NAT. HIST.

First, by means hereof a body is deprived of those exhalable parts that harbour'd in its pores, and were perhaps the principal of several operations ascribed to it. Secondly, as the want of these more subtile parts may induce a change of texture in the body, chiefly with regard to its pores, whose magnitude, figure and position being alter'd, the body may in many cases acquire a contrary disposition to its own.

Observation. Sometimes, when the weather began to be overcast, the hygroscope did not grow sensibly heavier, and at other times it wou'd, when I cou'd observe no vapours in the air. Indeed it happened thus but seldom, yet this made me suspect that some clouds may consist of other than aqueous exhalations; and that such as are peculiarly fitted to enter the pores of the hygroscope, have a faculty of drying it, or some way or other of increasing or lessening its gravity. And this seems the more probable, because having made hygroscopes with powder, with salt, and with wainscot saw-dust, applied to nice scales in very thin, light, open glasses, they all succeeded as the former; for now and then their weight would not alter as the weather grew moister or dryer.

Experiment 1. Soon after, looking upon the half hundred weight that hung by a rope, and fixing a mark where the bottom of it touch'd the perpendicular board that stood by it, I perceived the sky, which before was clear, to grow cloudy, but no rain ensued; upon this the weight rose a quarter of an inch within an hour and a quarter after the mark was made, as it proved, between nine and ten in the evening. Between eight and nine the following morning, it was raised near an inch from the former mark, when the day proving fair and windy, the weight sunk by ten at night about six inches below where I found it in the morning. The morning following, about eight a clock it was risen to 8 $\frac{1}{8}$ inches, the weather being then cloudy, tho' very dry and dusty; but in less than an hour after it overcast, and there fell some drops of rain, which made the lead to rise about half an inch higher.

The night proving rainy, the half hundred weight was lifted above five inches higher than I left it the preceding evening; but the day recovering to dry, windy, and warm, it was sunk by the next night considerably below all the marks. The rope whereby this weight was suspended, measured in diameter three eighteenths and four decimal parts of the tenth of an inch.

Experiment 2. A rope about three feet and a half in length from the point of suspension, and near three tenths of an inch in diameter, being stretched for some days by a leaden weight or quarter of the large hundred, which had a flat board placed underneath, just barely to support it; we at length moistened the rope thoroughly with water, by means of a spunge, whereby it first seemed to be rather a little lengthen'd than shorten'd; but in an hour or two it began to contract, so that the weight was raised considerably above the board whereon it rested before; on the same day, however, the weight sunk to its former place.

Tho'

Nat. Hist. *Observations.*

Tho' *Morocco* be an inland town, ſeated in a very hot climate, where the ſoil is uſually dry; yet I am imform'd that the nocturnal air proves exceeding damp and piercing, ſo as preſently to produce ruſt upon ſuch iron inſtruments as lie naked therein.

Air too moiſt cannot be wholeſom. The air about *Oakly* in *Buckinghamſhire*, tho' a high country, is very moiſt between *Michaelmas* and *Alhallontide*, eſpecially in rainy weather, and upon a thaw; ſo that the wainſcots, ſtair-caſes, and pictures, then ſtand of a water, which will afterward trickle down in large drops. But many houſes at *Brill*, which ſtand exceeding high, have this to a much greater degree; for here the ſtair-caſes, eſpecially if laid in oil, will run down with water. The north and north-eaſt ſides of theſe houſes are obſerved to be the dampeſt; for the furniture here will rot, if fires be not ſometimes made in the rooms wherein it ſtands.

Experiment 3.

As by exhauſting a receiver of air, we formerly tried whether the remaining medium wou'd thereby alter its temperature, as to heat and cold, ſo in the preſent experiment we endeavoured to find its diſpoſition with regard to dryneſs and moiſture. The hygroſcope made with the beard of a wild oat, ſeem'd very proper for this purpoſe; but that not being procurable, we uſed one of gut-ſtring. This was convey'd into a ſmall receiver, that the effect might be the more ſudden and conſpicuous; yet no ſenſible alteration appear'd in the index upon extracting the air. And tho' we repeated the experiment, and then kept the receiver for a conſiderable time exhauſted, the conſequence was the ſame; but upon the re-admiſſion of the air by the cock only, the index in a few hours conſiderably changed its place; ſo that hence the ſubtile matter in the ſuppoſed vacuum of the receiver, and conſequently the more fluid part of the atmoſphere, wherein the proper ærial particles float, appears not, in its own nature, to be very ſenſible either of cold or heat, dryneſs or moiſture; tho' many other experiments remain to be tried, beſides thoſe wherein the air-pump, thermometer, and hygroſcope are concern'd, before this can abſolutely be determin'd.

Clouds and miſts.

An excellent aſtronomer of my acquaintance, who frequently took the height of the clouds, very rarely found any of the white ones, in fair weather, to be more than three quarters of a mile, and ſeldom above half a mile from the ſurface of the earth.

A miſt driving upon the ſea towards the ſhoar, tho' without any ſenſible wind, will cauſe a greater ſwell of water than a brisk gale.

A moiſt bluiſh miſt has been obſerved to aſcend from ground that is ſomewhat moiſt in winter, and elſewhere after a warm day, or againſt fair weather in autumn, to the height of twenty or thirty feet, and then to ſubſide again in dew.

Terreſtrial ſteams in the air.

A virtuoſo of my acquaintance, who poſſeſſed a piece of ground wherein ran ſeveral veins of different metals and minerals, as alſo his ſon, a virtuoſo, told me, they had frequently ſeen pillars, as it were of fumes, aſcending thence like ſmoke, ſome whereof had no

NAT. HIST. ſcent, ſome an ill one, and ſome again a good one, tho' the latter happen'd but ſeldom. And I my ſelf have known diffuſive and laſting fogs that have proved very fetid.

Smoky ſteams frequently proceed from the air-ſhafts of mines whilſt they lye unwrought; and the charcoal made of the wood that grows near the mineral mines in *Cornwal*, affords a manifeſt, arſenical, and ſulphureous ſcent.

" A terrible exhalation aroſe from the *Cretan* ſea, at the beginning " of the ſummer of the year 721, which diffuſing it ſelf in the air, " cauſed it to appear all on fire. The ſea it ſelf was alſo, by huge " flaming ſtones that ſtarted from the iſle called *Hiera*, heated to a vio- " lent degree." *Journal de Savans.* 1685.

The atmoſphere a very compounded body.

The ſchools teach the air to be a warm and moiſt element, and conſequently a ſimple and homogeneous body. Many modern philoſophers have, indeed, juſtly given up this elementary purity in the air; yet few ſeem to think it a body ſo greatly compounded as it really appears to be. The atmoſphere, they allow, is not abſolutely pure, but with them it differs from true and ſimple air, only as turbid water does from clear. Our atmoſphere, in my opinion, conſiſts not wholly of purer æther, or ſubtile matter, which is diffuſed thro' the univerſe, but in great meaſure of numberleſs exhalations of the terraqueous globe; and the various materials that go to compoſe it, with perhaps ſome ſubſtantial emanations from the celeſtial bodies, make up together, not a bare indeterminate feculency, but a confuſed aggregate of different effluvia. One principal ſort of theſe effluvia in the atmoſphere I take to be ſaline, whch float variouſly among the reſt in that vaſt ocean; for they ſeem not to be equally mixed therein, but are to be found of different kinds, in different quantities and places, at different ſeaſons.

Salts in the air.

The arguments that ſhew ſubterraneous effluvia, in general, aſcend plentifully into the air, prove the ſame of ſaline ones in particular; ſince it has been demonſtrated, that immenſe quantities of common, nitrous, aluminous, vitriolic, and perhaps other ſalts, riſe among the various exhalations of the terraqueous globe. Nor is this the only means whereby the air may be impregnated with ſaline particles; for the action of the ſun upon the ſuperficial parts of the earth and ſea, will, alone, ſupply that fluid with ſwarms of them. And the quantity hereof may be greatly increaſed in ſeveral places by ſuch vulcano's as have open vents, by the ſmoke of the common culinary fires, *&c.*

We might here enquire, whether the ſalts of the air be really of different kinds; and if ſo, what thoſe kinds are; and how it comes by them?

Many learned men talk much of a volatile nitre in the air, as the only ſalt wherewith that fluid is impregnated. I own that the air, in many places, ſeems to abound in corpuſcles of a nitrous nature; but I don't find it proved by experiments to poſſeſs a volatile nitre. In all my practices upon ſalt-petre, I found it difficult to raiſe that ſalt by a gentle heat,

and

and ſpirit of nitre, which is drawn by means of a vehement one, has quite different properties from crude nitre, or the ſuppoſed volatile kind in the air; for 'tis exceeding corroſive. And even the earth dug from under an old dove-houſe, and diſtill'd with ſlow fires, yielded nothing like that wherewith theſe men ſuppoſe the air to be ſtored. I am content, however, to admit their ſuppoſition as ingenious, till farther evidence be given for it; and this ſeems not impoſſible to be produced, at leaſt as to particular times and places. For I would not be poſitive, that the ſubterraneous exhalations, or the rays of the ſun, never volatilize any of the nitrous particles they act upon, and elevate them into the air, without deſtroying their texture like our fires. But this will not appear to be the only ſalt that impregnates the air, if we conſider how vaſt a portion of the terraqueous globe is cover'd with the ſalt ocean, and what immenſe quantities of foſſil ſalt are dug up in *Poland*, *Hungary*, *Tranſylvania*, &c. that ſea ſalt is generally found mixed with nitre in the earth, and that it is with difficulty ſeparated therefrom. For hence it ſhould ſeem, that in many places, eſpecially near the ſea, the effluvia of common ſalt abound in the air equally, at leaſt, with thoſe of nitre. NAT. HIST.

In places abounding with marcaſites, there is a fretting vitriolic ſalt largely diſperſed thro' the air, which has been obſerved to rot the hangings of rooms, and other furniture; and to lie upon the ſurface of the ground in a whitiſh effloreſcence, after the ſun had heated the moiſt and blackiſh mould wherein it lay.

But farther, the air of particular places, as about great towns, &c. may likewiſe, probably, abound with volatile ſalts, of a contrary nature to acids. That places deep under ground may lodge ſuch ſalts, ſeems not unlikely from the experiment of an acquaintance of mine, who cauſed to be dug up, at the depth of ſeveral yards below the ſurface of the earth, a large quantity of a certain kind of clay, abounding in minerals; whence he obtain'd, by ſimple diſtillation, a conſiderable parcel of ſpirit and ſalt, greatly reſembling thoſe of urine or hartſhorn.

In places where much wood is burnt, numerous particles of volatile ſalt may eaſily be diſperſed thro' the adjacent air; for wood-ſoot, which is only that ſmall part of the ſmoke which adheres to the chimney-ſides, affords a volatile, ſaline ſpirit in great plenty; and not readily, unleſs by the ſcent, diſtinguiſhable from that of urine or harts-horn.

Moreover the putrefaction of animal ſubſtances may ſupply the air with volatile ſalts; ſince ſome putrefied urine will, without diſtillation, afford ſaline and ſpirituous parts, which by their ſcent, &c. diſcover themſelves to be volatile, even while ſwimming in their own large quantity of phlegm. The like, I believe, is obſervable in many vegetables; for ſome ſucculent ones being laid together in a heap, at a convenient ſeaſon of the year, that they might rot, I found them, when the putrefaction had arrived to a certain degree, to yield a ſurprizingly fetid ſcent, like

NAT. HIST. that of carrion; and that a vegetable will of it ſelf afford a dry volatile ſalt, I know by experience, having my ſelf obtain'd it from a ſpirituous ſeed, tho' I muſt confeſs, not without previous incineration; and only from two or three ſuch ſubſtances.

But the air of ſome places may, beſides thoſe ſimple ones already mention'd, contain ſome compound ſalts, ſince I have ſhewn, that particular ſaline ſpirits may meet and join together therein; as alſo that two liquors may be ſo order'd, that tho' one of them ſhall never, of it ſelf, afford any thing in a dry form; yet its ſpirituous effluvia meeting with thoſe of the æther, will produce a dry, volatile and ſaline body; which a mixture of the liquors themſelves would not.

The many ſaline effluvia that ariſe with the other ſubterraneous ſteams, cannot, all of them, be well ſuppoſed of a ſimple and uncompounded nature. A very intelligent acquaintance of mine, who viſited a vulcano in *America*, told me, that before he came near enough to the fire, to be very ſenſible of its heat, the ſkin of his face was ſo corroded, and the colour of his hair ſo changed by the exhalations, as to prevent his nearer approach thereto.

'Tis well known that about mount *Veſuvius*, the exhalations are of ſo ſaline and ſulphureous a nature, that they adhere to the orifices of its vents, like the flowers of ſulphur. And I have had ſtone brought me from ſome vulcano, with a white ſalt in its cavities; which, upon examination, proved a-kin to ſal armoniac, and eaſily ſoluble in water; one part being very volatile, and the other remaining ſomewhat fixt; whence it ſeems very probable, the ſalt was compounded in the bowels of the vulcano; great quantities thereof having, as I am credibly inform'd, been caſt up in the fiery eruptions; and therefore, ſince I found it ſublimable, it might, by that means, be largely diſperſed thro' the air.

Beſides theſe ſaline ſubſtances of a determinate ſpecies, there are poſſibly, at certain times and places, other corpuſcles in the air of a ſaline nature, but not reducible to any particular kind, which I therefore call anonymous. We have obſerved in old glaſs windows, belonging to high and ancient buildings, ſome panes corroded, as if they had been worm-eaten; which ſeems to argue, that ſharp and fretting particles had been carried thither by the winds whereto that glaſs was expoſed. But none of the ſalts beforementioned have the faculty of corroding common glaſs. Other inſtances might be produced upon this occaſion, but I reſerve them for another treatiſe.

To diſcover the ſalts in the air. The general method of diſcovering the ſalts in the air, may conſiſt of ſeveral particulars. Thus, in the firſt place, it might be proper to lay open to the air, ſuch bodies as have a diſpoſition to be affected by the ſalt, wherewith 'tis moſt likely to abound. For inſtance, if we ſuſpect the air to be impregnated with nitre, lime, or the like bodies, that imbibe or retain ſuch a ſaltneſs; died cloths or ſilks of ſuch particular colours as will fade or tarniſh with nitrous ſpirits, may be expoſed thereto. Where vitriolic effluvia are ſuppoſed predominant,

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NAT. HIST. *Experiment 3.*

We mixed an equal weight of copper-filings and powdered sal-armoniac together, and put them into a covered crucible, which was kept over a moderate fire till the salt had done fuming; when all the remaining dark-coloured mass that could be separated, being taken out, grosly bruised and exposed, for some time, to the air, it looked like a kind of verdigrease, a substance whose colour may be observed to vary according to the nature of the particular salts, which by corroding and incorporating with the copper, produce the pigment. But a parcel of the same mass being grosly powder'd, before the air could much affect it, and hermetically sealed up in a glass egg, and left in a south window, it did not appear discoloured, when the external surface of the other parcel resembled verdigrease; which argues the change of colour to have been made by the aerial salt, if the moisture of the air had no share therein, but as a kind of vehicle to the salt.

Experiment 4. By pouring some spirit of wood-soot on filings of copper, I obtain'd a deep azure-colour'd solution like ultramarine, which being suffered to dry in an open glass by the sole operation of the air, the colour presently became paler, resembling that of a good turquoise. The same success I, likewise, had with an urinous spirit, drawn from animal substances and copper-filings.

To describe the above-mentioned changes more particularly, would have been so exceeding difficult, that I did not attempt it; for few, besides painters, can distinguish all the usual variety of colours by proper names. And besides, perhaps there are some that no language can express, especially when they have been attentively viewed and considered; tho' by a knowledge herein it might sometimes be ascertained what substances in the air are denoted by such variations.

It does not appear that our inland countries abound considerably with corrosive salts, since the bars and casements of windows will not thereby be greatly impaired by rust, after they have endured the weather for twenty years; whence I conjecture, that kind of salt proceeds from the sea-vapours, or those raised by the burning of mineral coals.

" The pot being taken from the fire, and suffered to cool, is emp-
" tied of its pure nitre, that resemble white marble; the terrestrial part
" remaining at the bottom. The earth wherewith the solution was
" made, and the boughs of oak, or the like trees, are then to be alter-
" nately exposed to the air, and sprinkled with water, wherein nitre
" has been dissolved; and by this means, in five or six years time, it
" will be again fit for solution. The purer parts of the nitre thus
" generated, as also that which hangs upon the walls in wine-vaults,
" is to be mixed and boiled with the first solution. But if any place
" yield many of these veins, they should not immediately be laid up
" in the reservatories, but be first thrown on a heap in open spaces;
" for the longer they lie exposed to the air and rain, the better they

" grow

" grow; and in four or five months after this, fibres will ſhoot out, NAT. HIST.
" which are much more excellent than the veins. If a ſeparation do
" not happen in the ſecond boiling of the decoction, pour it out of
" the ſmaller veſſels into the larger, and let it be ſhut up therein,
" when alſo the copperas will ſeparate from the alum, and run into
" lumps; but that which will not concrete in the veſſels, ſhould be
" boiled again, and the earth that ſtays behind thrown back into the
" reſervatory, together with the veins, to be there afreſh diluted with
" water and urine. The earth remaining in the reſervatories after ſo-
" lution, becomes gradually more alum;nous and juicy, as that whence
" nitre was made." *Agricola de re metallicâ.*

A learned phyſician, who practiſed in the moſt ſouthern parts of the *Engliſh* colonies, told me, that the great-guns there are ſo ſubject to ruſt, that after lying a few years in the open air, large cakes of *Crocus martis* may, with a hammer, be eaſily beat off them; whilſt others that lay ſunk in ſalt-water, during the ſame time, were by no means ſo much affected. And as dew is only ſteams of the terreſtrial globe, the phenomena that manifeſt its power to work on ſolid bodies, may help to ſhew how much the air abounds with ſaline and ſubtile parts. The dew about the maritime places of *Braſil*, and even part of the inland country, a ſcholar, who had been there, aſſured me, not only gave a ruſt to knives, and ſuch like inſtruments, but alſo to coin. He added, that the *Portugueze* are there obliged to caſe their great guns, to prevent their being corroded by it, ſo as to break in diſcharging; and that he often obſerved it left a pure, white ſalt, like a hoar-froſt, on the graſs and trees. Another ingenious phyſician informed me, that at *Fahlun* in *Sweden*, noted for one of the beſt copper-mines of that kingdom, the mineral exhalations affect the air ſo, that their ſilver coin is frequently diſcoloured, and ſometimes turned black thereby; tho' cloſe tied up in ſeveral purſes, and lock'd up in ſtrong cheſts. He ſaid alſo, that theſe effluvia manifeſtly affected braſs, and to that degree too, as to occaſion ſeven crowns of that metal, reſerved in one of their principal churches, to remain unclean'd, and perfectly black; becauſe they foul'd ſo faſt, as render'd the trouble of keeping them bright almoſt endleſs. Theſe corroſive exhalations, he farther aver'd, penetrate the bars and veſſels of iron, that lie expoſed to the air, ſo freely, that friable ſcales of ruſt may, at no long intervals, be eaſily obtain'd therefrom.

A *Neapolitan* nobleman acquainted me, that during his ſtay at a country-houſe near *Naples*, he uſed frequently to ride upon a very ſulphureous ſoil, where, if his horſe trod pretty hard, a great crackling noiſe would ariſe; which, to a ſtranger, might have ſeem'd ſurprizing, and duſty ſulphureous fumes be raiſed, which ſeem'd ready to take fire, as ſometimes he thought they actually did; and having cauſed ſome turfs to be cut out of this ground, and laid together in a heap, he could, in the night-time, ſometimes obſerve the effluvia thence *Sulphur in the air.*

NAT. HIST.

thence plentifully ariſing to kindle in the air. The ſame honourable perſon likewiſe aſſured me, that in the late eruptions of mount *Veſuvius*, both he and others were greatly amazed at the prodigious height of the flame which ſhot up from that *Vulcano*; and that by means of a quadrant, they found it reach'd two miles above the top of the mountain. He added, that the adjacent earth would ſometimes tremble, that vaſt ſtones and heavy bodies would be diſcharged, and that he himſelf had there ſeen fiery maſſes of matter thrown into the air, each of them capable of filling a large room.

" The iſland has a ſhocking appearance; the proſpect from the port " is the ſea, and ſhore all black and burnt, by a ſmall rock that firſt " diſcovered it ſelf about ſixty years ago, vomiting out a prodigious " flame at a cavern of an immenſe depth. 'Tis not above eighteen " years ſince, on a ſunday night, that a terrible noiſe began at the " port of *Santorini*, reaching even to *Chio*, diſtant therefrom above two " hundred miles, which was ſuppos'd to proceed from the *Venetians* " fighting with the *Turks*; but at length it was found to be cauſed by a " fire underneath the port above-mentioned, which there caſt up, from " the bottom of the ſea, quantities of pumice-ſtones, with a force and " report as great as if they had been ſeverally diſcharged from a cannon. " The air of *Santorini* was by this means ſo infected, that abundance " of people were kill'd, and many loſt their ſight thereby, tho' they " recover'd it in a few days afterwards. This infection ſpread it ſelf " as far as the preceding noiſe had reached; for even at *Chio* and *Smyrna* " all the ſilver coin was changed red, both that in the pocket, and that " lock'd up in cheſts; and the ſame happen'd to the ſilver chalices in " the churches. The infection, however, vaniſhed in a few days time, " and the ſilver recover'd its native colour; but the pumice-ſtones that " were thrown up, cover'd the *Archipelago* to ſuch a degree, that for a " conſiderable time, when particular winds blew, the port was block'd " up with them; ſo that not the leaſt veſſel could paſs, till way was " made for it by their removal. And ſome ſcatter'd remains of them " may be ſeen to this day in the *Mediterranean*. *Seneca* tells us, that " *Santorini* is built upon mines of ſulphur, which doubtleſs gave oc- " caſion to this fire." *Voyage de Levant.*

'Tis a common obſervation, that thunder produces in the air a ſtrong ſmell of ſulphur; and I remember being at a town near the lake of *Geneva*, when the thunder was ſo violent, as greatly to terrify the inhabitants, tho' they were accuſtom'd to its ſhocks: I heard many complaints the next day of a ſtrong ſulphureous ſcent, that particularly proved almoſt inſufferable to the centinel who ſtood near the lake where the thunder fell.

" On *July* 24. 1681. The ſhip *Albemarle*, diſtant a hundred leagues " from *Cape Cod*, in the latitude of 48°, about 3 in the afternoon, meet- " ing with a thunder ſtorm, the lightning burnt the main-top-ſail, ſplit " the main-cap in pieces, and ſhiver'd the maſt. One of the claps of thun-

" der

" der here proved exceſſively loud, whereat the whole ſhip's crew were Nat. Hist.
" aſtoniſhed; when ſomething immediately fell from the clouds upon
" the ſtern of the ſhip-boat, which broke it into ſeveral pieces, ſplit
" one of the pumps, and damaged the other. It ſeem'd to be a betu-
" minous matter that caus'd this miſchief, ſmelling like fired gunpow-
" der, and continuing to burn in the ſtern of the boat till it was wholly
" conſum'd; for they cou'd not extinguiſh it by water, and attempting
" to diſſipate it with ſticks. But, what is more extraordinary, when
" night came on, and the ſtars appear'd, they found their compaſſes
" changed. That in the biddekel had its north point turned due ſouth:
" one of the two others, which lay unhung in the locker in the cabbin,
" pointed exactly as the former; but the north point of the third ſtood
" weſt. The polarity of their needles being thus changed, the ſailors
" were for ſome time at a ſtand how to work their veſſel; however, they
" afterwards ſailed a thouſand leagues in this manner. That com-
" paſs whoſe needle thus came to point weſt, was brought to *New-*
" *England*, where the glaſs being broke, and the air gaining entrance,
" it loſt its virtue. But one of the others is in that country poſſeſs'd by
" Mr. *Encreaſe Mather*; the north point of the needle remaining ſouth
" to this day."

An eminent planter of trees, gave me part of a branch, with a fiſſure in the bark, that ſeem'd almoſt to reach the wood, from one end to the other; tho' the lips of the wound were now grown over with new bark. The like hereto he obſerved in other branches of the ſame tree; and this, for ſeveral reaſons, he could aſcribe to nothing but lightning, which about that time had been very frequent; and many more trees, as well his own as thoſe of others, far diſtant from the former, were affected in the ſame manner. Theſe fiſſures looked not all one way, but reſpected ſeveral points of the compaſs; whence I am confirm'd in my ſolution of ſome odd phenomena of lightning, by comparing its irregular, winding motion, to that of a ſquib. However this ſtrange kind of fire may affect animals, 'tis not always pernicious to vegetables; as appears from the juſt mention'd wounds it makes in trees, which happily cicatrize of themſelves, without any farther damage.

Celeſtial influences in the air.

Beginning to conſider the properties of vinous liquors, their ſeveral diſtempers, and the method to preſerve them, I found it previouſly neceſſary to make an exact ſcrutiny into the air, its qualities, temper, and motion; with the influence it has upon all ſuch bodies. This led me into ſome thoughts, relating to the imperfection of our preſent theory of the planets. 'Tis certain, if this theory be not built upon a demonſtrable foundation, differences and errors will happen in our opinions of the motions of the planets, and the calculations of their places. But if we err in this reſpect, their ſeveral aſpects and influences cannot be juſtly determin'd; and conſequently, the phyſical uſe of theſe celeſtial bodies is wholly loſt, or becomes very uncertain.

NAT. HIST.

And truly, if aſtronomy cou'd not afford ſome aſſiſtance in aſcertaining the affections, diſpoſitions and alterations of ſeveral things here below, I ſhould grutch all the time and coſt; all the watchings and obſervations it requires. Several objections, indeed, are commonly produced, againſt any ſuch uſe or application to be made of this ſcience, and againſt the influence of the celeſtial bodies. But theſe chiefly proceed from the impoſture and ignorance generally found in the profeſſors of this ſcience; the palpable miſtakes, and great uncertainties as to predictions, under which it labours; and laſtly, from want of knowing the manner wherein the celeſtial bodies may affect each other. Such objections, however, if throughly conſider'd, do not, as I apprehend, make againſt the poſſibility of the thing, but wholly ariſe from the enormities and imperfections thereof; and theſe bodies may ſtill have a power to cauſe ſuch particular motions and alterations, as, in their extremes, will render themſelves univerſally perceptible. And this appears by undeniable experiments, not only in vegetables, but in animals, and that both in acute and chronic diſtempers; more particularly in lunatic, epileptic, paralytic, or lethargic patients. This is further demonſtrable, if the extreme motions in phyſics, be generation and corruption, and rariſaction and condenſation the mean ones; for allowing theſe bodies a ſhare in promoting the latter, their effects upon all other ſublunary things muſt be very conſiderable. Generation and corruption are, properly ſpeaking, the extremes of motion, rather than motions themſelves; for the deſign and effects of all phyſical motion, are, in ſtrictneſs, either generation or corruption; and all motion is hereby limited and bounded; for beyond theſe there is no phyſical progreſſion; ſince all things are corrupted to be generated, and *vice verſâ*. It muſt then be acknowledged, that nature makes uſe of motions between theſe two extremes; which mean ones muſt alſo be as oppoſite to each other, as the two extremes. And as the motions of rariſaction and condenſation are oppoſites, ſo they fall in with all the other inſtruments and phenomena of nature; the one corresponding to heat, the other to cold; the one to hardneſs, compactneſs and dryneſs; the other to ſoftneſs, ſweetneſs, maturity, *&c.* For theſe, among many other reaſons, I conclude, that generation and corruption, rariſaction and condenſation, are the ſimpleſt, plaineſt, and juſteſt analyſis, in nature, of all phyſical motions; ſince all motion purely phyſical, may, with eaſe, be immediately referr'd thereto, and reſolved therein.

A new uſe of aſtronomy.

'Tis evident, that all the properties of moiſture, heat, cold, droughts, winds, ſhowers, thunder, *&c.* employ'd by nature to produce the two univerſal effects, rariſaction and condenſation, almoſt wholly depend upon the courſe, motion, poſition, ſituation, or aſpect of the celeſtial bodies. Thus every planet has its own proper light, diſtinct from that of the others; which is either a bare quality, and then its utmoſt uſe and deſign is only to illuminate; or elſe all light is attended with ſome

pecu-

peculiar power, virtue, or tincture; whence 'tis plain, that every light has its peculiar property, tincture, and colour; its own ſpecific virtue and power, wherein the planets differ from each other; and conſequently the celeſtial bodies are not to be conſidered as ſluggiſh and unorganized matter; but as full of their proper motion, operations and life. Thus, the ſun not only ſhines upon all the planets, but by his genial warmth calls forth, excites and raiſes the motions, properties, and powers peculiar to them: whence, according to the angle they make with that grand luminary, and the degree wherein they are enlightened, either by its direct or oblique rays, in a near or remote ſituation in reſpect of the earth; the effects of the powers, virtues, and tinctures proper to each, muſt be more or leſs perceived by us. As for the manner wherein the planets tranſmit their powers, and thereby affect the remoter bodies, 'tis not difficult to apprehend it; for we affirm no virtue or power to flow from the planets, that comes not along with the light as a property thereof.

'Twas never imagin'd that any of the planetary or ſolar light is refracted, or otherwiſe weaken'd or diminiſhed by the æther, thro' which it paſſes; and conſequently 'tis not hinder'd from deſcending with its full force, directly and unrefracted, upon our atmoſphere. But whatever is received by the atmoſphere, muſt alſo be received by the thin and ſubtile air that is contiguous thereto; which air is, doubtleſs, capable of being moved, agitated, altered, and impreſſed by the properties, virtues, and lights that penetrate all its parts. Not only ſo, but our ſpirits alſo, with thoſe of all mixed bodies, will receive no leſs impreſſion, alteration, motion, agitation, and infection from the ſame lights; nay, as our ſpirits approach nearer to the nature of light than that of air, ſo will they be more affected thereby. And if the ſpirits, we ſpeak of, may be altered, changed, moved and impreſſed by theſe ſuperior bodies, and their properties; ſince ſuch ſpirits are the only principles of action, power, force and life in the bodies, wherein they reſide, and the immediate cauſes of all the alterations therein, 'tis impoſſible they ſhould be altered and changed, and the reſpective bodies remain unaffected thereby; conſequently the force of the ſuperior bodies muſt exert a power or operation on the very ſubſtance of the inferior. To confirm this, in particular, with regard to our ſelves, we might have recourſe to the miſchiefs that frequently befal mankind by means of the air, which ſeems no otherwiſe concern'd; ſuch are convulſions, cramps, blaſts, lameneſs, colds, *&c.* many whereof have a long duration, tho' rarely felt at the very inſtant of their approach, or attended with any perceptible exceſs of heat or cold.

As the other planets, ſo alſo our earth is not only enlightened, warm'd, cheriſh'd, and made fruitful by the power, virtue, and influence of the ſun; but it hath, moreover, its proper, magnetical, planetary force awaken'd, fermented, excited, and agitated; which it

NAT HIST. ſends back with the reflected light of that luminary. By this means alſo, the ſeminal diſpoſitions, odours, and ferments, lodg'd in particular regions and parts hereof, at the ſame time emit and diffuſe thro' the air either their kindly and grateful, or malignant, congeling, and putrefying qualities. Hence, tho' the temper, diſpoſition, and general qualities of the air may be aſſigned accoording to the motions, influences, and aſpects of the ſeveral ſuperior planets, yet the particular healthfulneſs and unhealthfulneſs of places; the bad diſpoſitions of the air, whether in the evenings, nights, or mornings; in ſome parts more than others; exceſſive moiſture, great winds, droughts, or ſeaſons peculiar to a country, ſhould chiefly be aſcribed to thoſe odours, vapours, and exhalations, that by the action of the ſun, or other planets, are forc'd from their particular ſeats in the planets themſelves into the air. Now if this be the ſtate of the caſe, it follows, that wholly to neglect ſuch a phyſical uſe of the motion of theſe bodies, becauſe ſuperſtition has crept into it, is very extravagant; and ought not to paſs uncenſur'd in men of learning.

In this apology for aſtrology, I, by no means, pretend to juſtify any thing farther than as it properly, or of neceſſity, falls under natural philoſophy; but I greatly ſuſpect, that if the theory of the planets were ſo well adjuſted and ſettled, by demonſtration, that we exactly knew the place, courſe, and poſition of every one of them; the doctrine of their phyſical uſe, with its weight, dignity, extent, and moment, would immediately become ſelf-evident; eſpecially if particular perſons would calculate the motions here to their own reſpective meridians, and compare them with their own daily obſervations of the alteration of the air. As this was, doubtleſs, the method firſt taken by the antients, to diſcover the efficacy of theſe bodies, by giving an hiſtorical diary of the weather and places, motions and aſpects of the planets, with their agreement, diſagreement, *&c.* the ſame procedure could not but prove ſatisfactory and delightful in the momentous doctrine we ſpeak of. And were ſuch a plain demonſtration of the power of theſe bodies, in general, once eſtabliſhed, the uſefulneſs of this ſcience in civil and œconomical affairs; in husbandry, gardening, and phyſic; and the ſhare they have in producing many other very ſurprizing effects, would be eaſily diſcern'd and credited. The preſent age ſeems better furniſhed than was ever any preceding one, to lay ſuch a foundation by means of thoſe extraordinary inſtruments the thermometer and barometer. And no man, who hath leiſure and opportunity, ſhould think it trifling to collect obſervations of this nature: 'tis certainly much more commendable to preſerve this kind of hiſtory of our own time, than to break out upon every occaſion; "This is the "hotteſt, this is the coldeſt, this is the moſt ſeaſonable, this is the moſt "unſeaſonable weather I ever felt;" when perhaps it's utterly falſe in fact. Did no other benefit accrue from theſe obſervations, they would tend to complete the natural hiſtory of any place; an inſtance whereof

The keeping a diary of the weather recommended.

we

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Nat. Hist. things are performable by the thermometer, I shall not now consider; but 'tis certain, that the great mechanic, *Cornelius Drebel*, did herewith contrive a dial, which had a continual, spontaneous, and regular motion, whereby it exhibited not only the times of the day, but also the celestial appearances; that he also made an automatous, musical instrument, and a furnace which he could regulate to any degree of heat, by means of the same instrument.

'Tis an approved tradition in *Java*, that the moon's rays will cause contractions in the bodies of those who are long exposed thereto. And an ingenious physician, who had practised there, assured me, he observed some persons become lame by this means; and so continue for many weeks, or sometimes months together. He also experienced it upon himself; for happening, whilst he was a stranger in that country, to sleep, after a very hot day, for a considerable time on the ground, that lay fully exposed to the moon; upon waking he found his neck exceeding stiff, and his mouth drawn awry in an hideous manner; which obliged him to keep within doors, till by the use of brisk aromatic medicines, he freed himself from that disorder. The coldness of the night, and the subtilty of the air, he said, were not the sole cause of these phenomena; the effects of those generally proving lighter, if the moon be unconcern'd.

An intelligent person having by a fall so broken his head that several large pieces of his skull were obliged to be taken out, he assured me, that for several months, during which he lay under the surgeon's hands, he constantly observed, that about full-moon, there would be extraordinary prickings and shootings in the wounded parts of his head, as if the meninges were stretched, or pressed against the rugged parts of the broken skull; and this with so much pain, as wou'd for 2 or 3 nights hinder his sleep, of which at all other times of the moon he used to enjoy a competency. This gentleman added, that his several surgeons, for he had 3 or 4 at once, observed from month to month, as well as he, the effect of the full-moon upon his head; informing him, that they then manifestly perceived an expansion, or intumescence of his brain, which appear'd not at all at the new-moon; nor was he then obnoxious to the forementioned pricking pains.

Motions of the air. From a letter, dated *Fort St. George*, Jan. 23. 1668. "There happen'd a dreadful storm, or rather hurricane here, on the 22d of *November*, when a tempest of wind and rain grew so exceeding violent, that nothing was able to stand against it: Men and beasts were thereby swept away together into the sea; few houses or trees escaped its force; the wall of the town was laid flat in several places; the buildings about the fort were uncover'd and greatly shatter'd; and the fort it self was so vehemently rock'd, that it seem'd ready to fall upon us."

Captain

Captain *Brookehaven* told me, that hurricanes are very frequent about the iſland *Mauſricius*; that he remembred one on the ſea not far from thence; which laſted four days; that upon one of them the ſtorm had ſeven paroxyſms, call'd by the ſailors, frights of weather, each whereof he obſerved to differ two points of the compaſs from the other ſucceſſively; and that by this means the ſurface of the ſea became a white froth. This ſtorm occaſion'd the day to be exceeding dark, and the noiſe it made ſeem'd more like that of thunder, than of wind; which was ſo loud, that thoſe on the deck of the ſhip cou'd not hear thoſe on the ſhrouds. Nat. Hist.

A phyſician who had been in *America*, aſſured me, that none but the hilly part whereof had conſtant winds from the land in the night time; and that, therefore, *Barbados* was without them.

One of the *Eaſt-India* committee, who had lived in the iſland of *Teneriff*, told me, he uſually obſerved the breezes there to proceed from the ſea, about nine of the clock in the morning; and that, two hours after the ſun-ſet, there blew a ſharp, land-gale from every part of the iſland towards the ſea, which continued all the night.

A learned traveller acquainted me, that tho' the air were generally calm and clear on the tops of the mountains; yet he had ſometimes there met with winds conſiderably ſtrong.

In a letter from *Venice*, dated *Auguſt* 29th 1679. "There aroſe "a kind of whirlwind in the fens of the city *di Favis*, three miles "diſtant from *Palma*; which ſpreading about 50 paces in breadth, "ſwept along with ſuch fury, that it carried up into the air ſeveral "hay-makers in the neighbouring meadows, with loaden waggons, "horſes, oxen and all; caſting 'em down a large diſtance off, ſhatter'd "and ruin'd. In its progreſs it tore up all the herbs and plants it "met with, and even pared, and burnt the turf. At its arrival in the "little *Venetian* town *Bagnaria*, it overturn'd ſeveral houſes to the very "foundations, and uncover'd others; hurrying along with it beams, "pillars, tables, and all the furniture and moveables, and bruiſing "many perſons, tho' without killing any. It ſtript the church "S. *Thomaſo*, near the town, quite bare; carrying away the very "ſteeple and bells, which were not yet found the next day. Hence "it turn'd towards *Sevigliano*, where it deſtroy'd the whole champaign, "tho' without doing any damage to the town. A little farther it threw "down the palace of the Count *Horatio Straſoldo*, and took away with "it in the air various kinds of animals and moveables, and even the "very veſſels out of the cellars: yet no body was hurt, the family "being moſt of them at work in the fields. In its way to *Straſoldo* it "threw down two other houſes, killing therein a lady, a young man, "and ſeveral beaſts. Hence turning towards *Palma*, and arriving at "the walls of the fort, on the ſide of the city *Privano*, it beat it to "pieces, overturn'd ſome very fine palaces, killing ſeveral perſons, "and wounding others; and doing great miſchief to the grounds.

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" It then advanced to the city *di Viſco*, belonging to the Emperor,
" where, among other conſiderable damages, it ruin'd the new palace
" of *Marco Foſcolini*, wherein was a large coach-houſe, the door where-
" of was faſten'd by three bolts; but the wind entering in at the bal-
" cony, burſt open the door, ſhatter'd it to pieces, and threw it upon
" a high court-wall, carrying the ceiling of the room half a mile fur-
" ther; wounding ſome of the ſervants, and killing two perſons in the
" ſtreets. This done, it attack'd S. *Vido di Crauglio*, a town belong-
" ing to the Emperor, which it ruin'd entirely, ſo as not to leave a
" ſingle houſe; killing and wounding great numbers. Hence it pro-
" ceeded to *Villes*, a great part of which it levell'd with the ground;
" deſtroying men and other animals; and leaving the fields as bare as a
" beaten way. Other towns have ſuffer'd from it in a like manner,
" tho' in a leſs degree."

I learnt from a phyſician, that tho' the eaſtern winds blow near three quarters of a year at *Tangier*; yet they ſeem not to ſpread far into the inland country, becauſe, he found them there to be very unfrequent.

An ingenious gentleman, who poſſeſſes a mine or two near the ſea, inform'd me, that he cou'd preſage the change of wind, at the depth of between 15 and 20 fathom in them. For, many hours before it veer'd from any other point to the ſouth, the water at the bottom of the mine would appear thick; and when 'twas upon changing to the eaſt, the water became unuſually clear.

The hurricanes about *Goa*, as the ſame gentleman ſaid, generally happen but at two ſeaſons; *viz.* about the beginning of *March* and of *October*.

Prognoſtics of hurricanes at Bermudas.

The late governor of the *Bermudas* iſlands inform'd me, that theſe were of the principal forerunners of the hurricanes there. The ſea would manifeſtly ſwell at ſome diſtance from the ſhore, ſo that the fiſhermen often made to land, and warn'd the inhabitants, upon the confidence of that preſage, to provide againſt the ſtorm, tho' the ſea were then ſmooth enough. The ſea would beat with great noiſe againſt the ſhore, eſpecially the rocks, tho' there appear'd no manifeſt cauſe for it, as upon account of the wind or tide: and this ſign would ſometimes not be given till many hours, or perhaps a full day after the former. Sometimes alſo 'twas obſerv'd, that the ſea would ſuddenly invade the ſhore, and gain further upon it than could be accounted for by the wind or tide, and then quickly ebb away beyond the uſual low water-mark, and after return again with more fury, and fall back further than before. Sometimes there would be perceiv'd an ungrateful ſmell in the air, before the hurricane began. And laſtly, he affirm'd, that both he and others had ſeen in the air many bundles, as it were of long ſtreaks of different colours; which by reaſon of their figure are uſually there call'd horſe-tails: and theſe appear'd in ſuch parts of the ſky, where the air was troubled indeed, but no form'd clouds were viſible.

A gentle-

A gentleman told me, that being off the coaſt of *Moſambique*, to- NAT. HIST.
wards the latter end of *September*, the captain of the great *Portugal* ſhip wherein they were, ſpied, as he walked upon deck, a very little dark cloud, or blackiſh ſpot in the ſky, a great way off; upon which, tho' the weather was then fair, he immediately provided for a ſtorm; and when the cloud approached, the wind, which before had filled their ſails, ceaſed, and the ſea became calmer than before; but preſently after they had a furious hurricane, which ſeveral times turn'd their ſhip quite round; and laſted for above two hours.

The air's operation on the ſounds of bodies.

" When ſeveral tempeſts riſe together, the ſky is of a ſudden co-
" ver'd over with thick, black, globular and ſmoky clouds; when
" immediately the thunder burſts out on every ſide with inceſſant flaſhes
" of lightning, able to ſtrike terror into the moſt reſolute, and thoſe
" accuſtom'd thereto." *Ludolf*'s Hiſt. of *Æthiop.*

The ſtring of a viol has by a gentleman been obſerved to increaſe the ſharpneſs of its ſound by almoſt half a note, either a little before, or in rainy weather. The ſame perſon alſo aſſured me, that having put falſe ſtrings into his pocket for frets, he has ſometimes, when he came to make uſe thereof, found them true. He further obſerves, that ſome ſtrings are apter to receive a tenſion from the moiſt air than others.

An ingenious and credible perſon aſſured me, that in one of the fine gardens near *Genoa*, there is a pond on the ſide of a hill, where the wall being ſo high, that men could not look over it, nor be at all ſeen over it by the fiſh in the pond; yet that he has ſeveral times obſerved thoſe fiſh to be called together by the gardener, with a certain noiſe he made for that purpoſe; tho' neither this gentleman, nor any one elſe, could be diſcover'd by the fiſh that readily obey'd the ſummons.

The weight of the air, with its effects.

The different weight of the atmoſphere at different times may perhaps have a conſiderable influence on the human body, with regard to health and ſickneſs. Thus, when the air grows of a ſudden much lighter than uſual, the ſpirituous and aerial particles plentifully lodged in the blood, will naturally ſwell that liquor; and ſo diſtend the greater veſſels, and alter the manner of the circulation thro' the capillary veins and arteries: whence ſeveral changes may happen in the body.

Having three ſmall, round glaſs bubbles, blown at the flame of a lamp about the ſize of hazel-nuts, each of them with a ſhort, ſlender ſtem; by means whereof they were ſo exactly poiſed in water, that a very ſmall change of weight would make them either emerge or ſink; at a time, when the atmoſphere was of a convenient weight, I put them into a wide-mouth'd glaſs of common water, and leaving them in a quiet place, where they were frequently in my eye, I obſerved, that ſometimes they would be at the top of the water, and remain there for ſeveral days, or perhaps weeks together; and ſome-

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times fall to the bottom; and after having continued there for some time, rise again. And tho' sometimes, especially if I removed the containing vessel to a south window, they would rise or fall as the air was hot or cold; yet these motions were easily distinguishable from those produced by the varying gravity of the atmosphere. For when the sun-beams, or the heat of the ambient air, by rarifying the air included in the bubbles, caused that air to drive out some of the water, and consequently made them specifically lighter than water, tho' the bubble necessarily floated whilst the included air was thus rarified; yet when the absence of heat cooled, and consequently condensed the air, more water being intruded into the bubble, it must necessarily sink; and this wou'd commonly happen at night, if not before. But when the bubbles either rose or fell, by means of the different weight of the atmosphere, it appear'd, by the barometer, that the atmosphere was so heavy, or so light, as to be the cause thereof. So that I could often foretel the station of the mercury in that instrument, from the phenomena of these bubbles. And tho' whilst the atmosphere was not considerably either too light or heavy, the changes of the air, as to heat or cold, wou'd affect the bubbles, and make them often change places in the compass of a day; yet if the atmosphere were either very heavy or very light, the bubbles wou'd continue at the top, or the bottom of the water, for many days together; whilst the atmosphere did not change its gravity. And once, when the mercury stood high in the barometer, I set the glass for two or three days in a south-window, about noon, in the sun-shiny weather; yet even then the bubbles did not emerge; tho' it appear'd by a good sealed weather-glass, kept in the same window, that the ambient air was much warmer, than at other times, when the bubbles had rested on the top of the water. It being very difficult to poise several bubbles exactly, one as well as another, 'twas no surprize to me that all the three bubbles did not constantly rise and fall together. 'Twere, therefore, proper to poise a great number of bubbles together, that after trial made of all, the fittest might be chosen for this purpose. Sometimes a bubble that floated when first poised, wou'd after a while subside without any manifest cause; or if made to sink by such a cause, wou'd continue at the bottom after that cause was remov'd; which seemed to depend upon the water's imbibing, as it were, certain aerial particles. The experiment, however, did sometimes answer expectation; which shews, that as the atmosphere is heavier or lighter, 'tis able to affect bodies under water; so that the air must press upon the water it self, by the intervention whereof it exercises its power; whence consequently the atmosphere is incumbent, as a heavy body, upon the terraqueous globe.

A statical barometer.

Making choice of a large, thin, and light glass bubble, blown at the flame of a lamp, I counterpoised it with a metalline weight, in a pair of scales that were suspended in a frame, and wou'd turn with

the 30th part of a grain. Both the frame and balance were then placed near a good barometer; whence I might learn the preſent weight of the atmoſphere; when, tho' the ſcales were unable to ſhew all the variations that appear'd in the mercurial barometer, yet they gave notice of thoſe that alter'd the height of the mercury half a quarter of an inch; and if the ſcales had been more tender, and better accomodated, much ſmaller alterations might, doubtleſs, have been diſcern'd. By this means, however, the bubble did ſometimes balance the weight, and ſometimes this wou'd greatly preponderate; and that for different ſpaces of time, as the weight of the air continued. And thus the matter of fact was eſtabliſh'd by repeated obſervations and compariſons, made with ſeveral of theſe new barometers together. The foundation of this invention is as follows. The glaſs bubble, and its counterpoiſe, tho' at firſt exactly of the ſame weight in air, are very different as to bulk; the bubble being perhaps two hundred times bigger than that. And if two bodies of equal gravity, in a certaim medium, but of unequal bulk, be weigh'd in a different medium, they will no longer balance each other; if the new medium be the heavier, the larger body, becauſe ſpecifically lighter, will loſe more of its weight than the leſs and more compact. But if the new medium be the lighter, the larger body will overbalance the leſs. And this difference ariſing from the change of the medium, will be proportionable to the inequality in the bulks of the originally equiponderant bodies. Hence it muſt prove the ſame thing, as to the effect, whether the bodies be weigh'd in mediums of different gravity, or in the ſame medium, whoſe ſpecific gravity conſiderably alters. NAT. HIST.

Since, therefore, it appears, by the barometer, that the air is ſometimes heavier, and ſometimes lighter, its alterations in this reſpect muſt unequally affect a large, hollow bubble, and a ſmall, denſe weight, once balanced in a pair of ſcales; ſo that when the air grows heavier, it muſt buoy up the glaſs more than the counterpoiſe; and when lighter, ſuffer that to preponderate. The glaſs bubble here employ'd was hermetically ſealed; being equal in bulk to a large orange, and in weight one dram and ten grains. 'Tis poſſible to procure one more convenient than this, if care be taken not to ſeal it up whilſt hot; for by that means the internal air being rarified, the glaſs will be eaſily broke by the force of the external. Two ſmall bubbles, which are eaſily procured, may, upon occaſion, ſerve inſtead of a large one, which it may prove difficult to obtain.

This inſtrument is improveable in ſeveral reſpects. A graduated arch of a circle might be fitted to the top of the balance, for the point of the cock to play in; and by that means readily give the angles from its perpendicular poſition. A gold weight may be ſubſtituted for one of braſs. The ſeveral parts of the balance being made of copper or braſs, will be leſs ſubject to ruſt than ſteel. Inſtead of ſcales, the bubble may

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be hung at one end of the beam, and the weight at the other. If the whole inſtrument, placed in a ſmall frame, be included in a glaſs, open at the top, to admit a free paſſage to the air, 'twill be thereby preſerved from ruſt and irregular agitations. A light wheel and an index would enable it to ſhew very minute variations. And laſtly, a proper length of beam, and an exquiſite balance, may, alone, render this inſtrument far more exact than thoſe I was reduced to employ. In ſome reſpects, indeed, the ſtatical is inferior to the mercurial barometer; but in others it has peculiar advantages. As for inſtance, it firſt demonſtrates to the eye, that the riſe and fall of the quickſilver in the common ſort, proceeds from the different weight of the atmoſphere; for it cannot here be pretended, that an abhorrence of a vacuum, or a funicular power, is the cauſe of the variation. And 2. that the air is a more ponderous body than ſome learned men will allow. 3. 'Twill frequently be found more eaſily procurable than the other. 4. 'Tis very portable, and little liable to accidents, in removing it from one place to another. 5. Here is no uncertainty as to its goodneſs, as in the mercurial kind; where the air may be more or leſs excluded. 6. Both the abſolute and reſpective weight of the air is hereby nearly diſcoverable; for 'tis eaſy to find hydroſtatically the bulk of the bubble, and the contents of its cavity, with the weight and dimenſions of the glaſs whereof 'tis compoſed; if the ſcales, therefore, be brought to an equilibrium, by ſmall weights, when the mercury in the common barometer, is either very high, or very low, or elſe in a medium between both, obſerve when the quickſilver, either riſes or falls, for inſtance, an inch, and then by adding weights to the aſcending ſcale till the beam again becomes horizontal, you'll find what weight anſwers that determinate riſe or fall of the mercury: and if the balance be furniſhed with a graduated arch, or a wheel and index, theſe obſervations may ſerve, for the future, readily to ſhew how much the bubble gains or loſes by a change in the weight of the atmoſphere. Some obſervations of this nature I carefully made, by adding a 64^{th}, 32^{d}, or a 16^{th} of a grain to the lighter ſcale; but an accident hindred me from bringing them to perfection. 7. This inſtrument will farther aſſiſt us in comparing the mercurial barometers of ſeveral places, to make ſome eſtimate of the air's gravity there. For inſtance, ſuppoſe the bubble employ'd weighs juſt a dram, when the mercury ſtands at 29 $\frac{1}{2}$ inches; and that the 16^{th} part of a grain is required to reduce the bubble to an equilibrium, when the mercury riſes an 8^{th} above its former ſtation. Suppoſe alſo, that removing my inſtrument to another barometer, equally freed from air with the former, when, if the bubble here retains the weight of a dram, and the mercury ſtands at 29 $\frac{1}{2}$ inches, we may conclude, that the weight of the atmoſphere is the ſame at both places; how remote ſoever they may be. But in caſe there be no barometer at this latter place, yet if, by the 16^{th} part of a grain added to the bubble, I bring the ſcale to an equilibrium, 'tis plain,

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NAT. HIST.

But as moſt of the barometrical obſervations are ſubject to exceptions, ſo I found the forementioned to be. For (to omit leſſer variations) riding one evening from *Oxford* to *Stanton*, and having before I took horſe look'd on the barometer in the former of theſe two places, I was ſomewhat ſurprized, to find at my coming to the latter, that in places no farther diſtant, and notwithſtanding the ſhortneſs of the time (which was but an hour and half, if ſo much) the barometer at *Stanton* was ſhort of its uſual diſtance from the other near a quarter of an inch; though the weather being fair and calm, there appeared nothing of manifeſt change in the air, to which I could aſcribe ſo great a variation; and tho', alſo, ſince that time the mercury in the two inſtruments hath, for the moſt part, proceeded to riſe and fall as before.

The quickſilver has been of late, for the moſt part, ſo high, as to invite me to take notice of it; and about *March* 12. 166$\frac{3}{4}$ at *Oxford* the quickſilver was higher than, for ought I know, has been yet obſerved in *England*, *viz.* above $\frac{15}{16}$ above 30 inches; but upon the firſt conſiderable ſhowers, that have interrupted our long drought; as I foretold ſeveral hours before, that the quickſilver would be very low, (a bluſtering wind concurring with the rain) ſo I found it at *Stanton* to fall $\frac{3}{8}$ beneath 29 inches.

It is difficult enough to ſettle any general rule about the riſing and falling of the quickſilver; yet in theſe parts one of thoſe that ſeem to hold oftneſt is, that when high winds blow, the mercury is the lower; and yet that it ſelf does ſometimes fail. *

° *The weight of a cubic inch of water, and of quickſilver.*

° Having procured an exact, concave cubic inch of braſs, and carefully balanced it in a nice pair of ſcales, by eleven drams one grain and a half, troy-weight, it was cautiouſly filled with clear, pump water, till the ſurface thereof appeared level with the upper edges of the metal; then weighing the water, it equall'd 254 $\frac{7}{16}$ grains; we may therefore, without any ſenſible error, ſuppoſe a cubic inch of water to weigh 256 grains; which agrees very well with ſome other experiments I made to diſcover the ſame. The metalline cube was afterwards dried and counterpoiſed afreſh, and filled as exactly as poſſible with diſtill'd mercury; the weight whereof, alone, we found to be ſeven ounces, two drams, troy; but by adding a little, without making it run over, the whole inch of mercury equall'd ſeven ounces, three

* 'Tis found that the mercury in the barometer deſcends upon violent guſts of wind; and Mr. *Hauksbee*, to ſolve the phenomenon, contriv'd an experiment, wherein an artificial blaſt of air ſo leſſened the preſſure of the atmoſphere, upon the ſtagnant mercury in the ciſterns of two barometers at once, that the columns ſuſtained, were thereby made to deſcend two inches; tho' one of the barometers was diſtant three feet from the ſtream of air. And hence 'tis very obvious, as Mr. *Hauksbee* obſerves, "that different forces and different directions of the wind, may produce different "degrees of ſubſiding in the barometer; and "that ſtrong winds may, by thus altering the "preſſure of air, greatly affect the animal "œconomy." *Hauksbee's Experim.* p. 114, ----119.

drams,

drams, twenty-two grains. The eye now placed in a level with the brims of the veſſel, diſcover'd the mercury a little above them; however, it ſtill received 112 grains more of mercury, without running over; and more, perhaps, might have ſtill been added. From hence it appears ſcarce poſſible to determine by this means, the exact weight of a cubic inch of quickſilver. And ſince by other trials I have found the weight of mercury to that of water, of the ſame bulk, in a ſomewhat leſs proportion than of 14 to 1; the weight of a cubic inch of quickſilver may well enough be ſuppoſed 3580 grains; and conſequently, when a column of quickſilver, thirty inches high, is ſuſtain'd in the barometer, as it frequently happens, a column of air that preſſes upon an inch ſquare near the ſurface of the earth, muſt weigh above fifteen averdupoize pounds. NAT. HIST.

What quantity of air preſſes upon a ſquare inch.

As 355 to 452, ſo is the area of a ſquare inſcribed in a circle, to that of the circle circumſcribed; whence 355. 452 :: 1. 1,2732394. If, therefore, the ſide of an inſcribed ſquare be an inch, that ſquare multiplied by another inch, gives an inch in ſolid meaſure. Thus if a cylinder, an inch in height, be erected upon the circle circumſcribed; the ſolid content thereof will be 1,2732394. Hence 1, and 1,2732394, being multiplied by the weight of a cubic inch of any metal, you have the weight of a cubic inch, and of a cylindrical one that circumſcribes the ſame; whence an inch table for both is eaſily made, by continual addition, or for any given height, if you multiply both thereby.

Fig. 2.

" The ſyphon B O, was ſealed at the end O, but open at B; the " bend from G to C containing mercury, and the other parts no- " thing but air. The diſtance from O to C was four inches, or $\frac{32}{8}$. " By heating the air, the mercury ſunk to F, $\frac{3}{8}$ lower than it ſtood " before, and at the ſame time roſe in the other leg to H, $\frac{3}{8}$ higher " than G or C. To find what height of mercury was required to " hinder the expanſion of the air, and continue the mercury at C, " we need only try how much wou'd ſerve to force it back again " to C; and thereby retain the air in the ſpace O C, notwithſtand- " ing the force of the heat. I ſuppoſe it known from experience, " that when a quantity of air poſſeſſes any ſpace, which we call A, " and the force, B, that retains it therein, be increaſed in any degree, " ſuppoſe it X, the ſpace A will be thereby diminiſh'd in a certain " quantity D, which is to the remainder M, as X to B, thus, D. M :: " X. B. and conſequently M. D :: B. X. This rule may be eaſily ap- " plied to our preſent experiment; for herein O F, $\frac{31}{8}$ inch, is the " ſpace A; and the uſual preſſure of the air, equal to thirty inches of " mercury, added to the one inch between F and H, anſwers to B and " X, or thirty one inches of mercury; and if a proper quantity be " added to reduce the air into the ſpace O C, the ſame O C, will be " M, $\frac{32}{8}$, and F C, be D, $\frac{3}{8}$; whence the three quantities $\frac{\text{M. D :: B.}}{\text{32. 3 :: 31.}}$ are

" given

NAT. HIST. " given to find a fourth proportional, 2 $\frac{29}{32}$; which added to B, 31, make
" 33 $\frac{29}{32}$ inches, whereby the air is forced into C O, that is, near 4 inches
" more than the ordinary preſſure.

" A ſufficient number of exact ſurveying chains, being fix'd to a
" well-purged barometer, conveniently framed; the mercury ſtanding at
" 30 inches and 50 cents; we drew it up to the firſt floor of *Sarum* ſtee-
" ple, 1033 $\frac{1}{2}$ inches from the pavement, when the quickſilver was ſunk
" 9 cents; then raiſing it to the middle floor, that is, 935 inches above
" the former, it fell 8 cents lower; and when arrived at the weather
" door, that is, 2313 inches ſtill higher, it ſubſided 23 cents more.
" The whole height was therefore 4281 $\frac{1}{2}$ inches, and the whole differ-
" ence of the mercury's ſinking, 40 cents of an inch. Upon letting
" down the barometer to the ſame places, the quickſilver ſeverally roſe
" to its former ſtations.

" At another time we uſed an inverted barometer in the like manner;
Fig. 3. " when the fluid of it roſe therein as follows.

At the height of	*Inches*	The liquor aſcended	*Inches*	*Cent.*
	1033 $\frac{1}{2}$		1	25
	1968		2	39
	2467		3	22
	4281		5	64
	4800 or the top.		6	40

At a place on the great continent of *Europe*, but not far diſtant from the ocean, a learned acquaintance of mine lately obſerv'd the mercury in his barometer, the weather being calm and ordinary, to riſe ſuddenly above two inches higher than the uſual ſtandard; which phenomenon was, in a few hours, followed by a prodigious and deſtructive ſtorm, that blew from off the continent. The ſame gentleman obſerves, that when ſtorms here blow from the ſea, which lies to the ſouthward, the quickſilver ſinks conſiderably; as hath alſo been obſerved in *England*, by an ingenious perſon, who lives near two leagues from the ſea. One whom I bred up to chymiſtry, was a few days ſince, ſurprized, to find the mercury in his barometer at *Oxford*, ſink on a ſudden greatly, while the weather continued fair and warm. The day, in four or five hours after, was overcaſt, and there happen'd a dreadful ſtorm of rain, lightning, and thunder; with ſuch a ſtrong whirlwind as had ſcarce ever been remembred in that city.

In a letter from Mr. *Locke*. " The deepeſt gruffs or pits I could hear
" of at *Minedeep*, were about 30 fathom, but the deſcent into them
" is ſo exceeding difficult, dangerous, and impracticable to a ſtranger,
" that I durſt not then attempt to go down with a barometer; for they
" are not ſunk like wells perpendicularly, but as the cranies of the
" rocks happen to run. The conſtant method is, to ſwing down by a
" rope placed under the arm, and clamber along by applying both

" feet and hands to the ſides of the narrow paſſage. When damps happen herein, if the miners cannot get out, they ſoon faint and die: but if they be ſeaſonably drawn up, a hole being dug in the ground, their faces are placed therein, and covered cloſe up with turfs; which is the ſureſt method they have hitherto found to recover them. After the uſe of fire in their pits, they find it very dangerous to deſcend, as long as any heat remains in the clefts of the rocks. Air is convey'd into them thro' a little paſſage that runs along the ſides from the top; where they ſet up ſome turfs on the lee ſide of the hole to catch and force it down. Theſe turfs being removed to the windy ſide, or laid over the mouth of the hole, the miners below preſently want breath, are indiſpoſed, and faint: and if ſweet flowers chance to be there, they immediately loſe their fragrancy, and ſtink like carrion. Being unable at this time, to make any experiment with the barometer in theſe gruffs, I carried it to the top of a high hill adjoining; when the mercury, which below ſtood at 29 $\frac{1}{8}$ inches, was now ſunk to 28 $\frac{3}{4}$ inches. In aſcending and deſcending, I found the quickſilver to fall and riſe proportionably to the height where I ſtood. But at my return to the foot of the hill, it wanted $\frac{1}{52}$ inch of the ſtation it there had before; which I impute to the rarifaction of the air remaining in the upper part of the tube." NAT. HIST.

The king was lately pleaſed to tell me, that taking water from *Whitehall*, to ſail towards the river's mouth, in exceeding fine weather; upon which being congratulated by the courtiers, his majeſty bid them prepare for a ſtorm; which, in a few hours, happen'd accordingly; and drove vehemently upon the yacht for ſeveral leagues together. The king, before he went on board, had privately obſerved the mercury in a good barometer, to ſink very remarkably.

" Since the water in pumps, and the external air, mutually balance each other, they muſt have the ſame weight; whence if the height whereto water riſes in any part of the world be known, by what weight of the incumbent air that part is preſſed, will be known alſo; and therefore, the places by the ſea ſide are preſſed by the weight of the whole incumbent atmoſphere, as much as they wou'd by a column of water 31 feet 2 inches high; thoſe that riſe ten fathom above the former, as much as if they ſuſtain'd one of 31 feet, 1 inch; and thoſe that lie 500 fathom higher than the ſea, are preſſed as by a column of water of 26 feet, 11 inches, *&c.* Hence it appears, that the air which ſtands above the level of the ſea, is equal in weight to water 31 feet, 2 inches high: but becauſe air is lighter upon places above that level, and therefore preſſes not all the points of the earth equally; and being alſo of different weights in different places, there is no certain rule to determine the exact quantity of air, whereby, one with another, all the parts of the world are preſſed. This, however, may be tolerably done in a conjectural

NAT. HIST. " way; for example, by ſuppoſing, that if all the parts of the earth " were equally preſſed with air, 'twou'd be the ſame as if they ſup- " ported water to the height of 31 feet; and 'tis certain we cannot " err half a foot in this ſuppoſition. But we have ſeen, that the air, " at the height of 500 fathoms above the ſurface of the ſea, is equal " in weight, to water 26 feet, 11 inches high; and conſequently, the " air, from the ſurface of the ſea to that height, weighs as much as " water of 4 feet and an inch high; that is, near a ſeventh of the " whole height; whence 'tis plain, that the air between the ſea and the " ſame height, is nearly a ſeventh part of the whole aſmoſphere.

" 'Tis known alſo, that the vapours collected in the air, weigh, " when moſt numerous, no more than water of a foot and eight inches " high; ſince that additional height of water will balance them in " pumps: ſo that were all the vapours that hang over a whole " country to deſcend in rain, they would only make that quantity of " water; for if more happens to fall, it's owing to the winds driving " the vapours thither from other parts. Hence, likewiſe, it appears, " that if the whole atmoſphere was preſſed againſt the ſurface of the " earth, by a force applied to its upper ſurface, and thereby reduced " to the denſity of water, 'twou'd then be no more than 31 feet in " height. The atmoſphere, therefore, in its free ſtate, may be con- " ſider'd as if it had once been water, covering the earth, to the " height of 31 feet; but afterwards exceedingly ratified, expanded, " and converted into what we call air; tho', in fact, it poſſeſſes a " larger ſpace, but has not a greater weight than water of the height " of 31 feet. Now, 'tis exceeding eaſy to compute, what quantity of " water wou'd every way ſurround the earth to that height; which " gives the whole weight of the air. For, ſince a cubic foot of water " weighs 72 pounds, a priſm thereof, (to uſe that for the ſector of a " ſphere) whoſe baſe is a foot ſquare, and height 31 feet, will weigh " 2232 pounds; and ſince the ſurface of the earth contains " 3711.420000.000000 ſquare feet, the product of theſe two ſums, " which is 8.283889.440000.000000 pounds, gives the quantity of " water, and conſequently the quantity of air required."

" To render the weight of the air ſenſible, I cauſed a very light, " glaſs bubble, A B, to be blown retort-faſhion, about the bigneſs of
Fig. 4. " a common ball, with the aperture B, capable only of admitting an " hair; and finding, by a very tender balance, its weight to be 78 ½ " grains when cold; I heated it, and placed it again in the ſcale upon " its end B, when it ſcarce weigh'd 78 grains; then plunging its " orifice into water, whilſt the glaſs cool'd, and the contain'd air " condenſed; as much water enter'd into it, as air had been forced out " by the heat. Coming now to weigh the bubble again, I found it had " gain'd 72 ½ grains; whence I ſuppoſe the air expell'd by the heat, " was to the water that came in its place, as ½ to 72 ½, or as 1 to " 145; and tho' this cannot hence be determin'd with exactneſs, yet

" at

" at leaſt, the experiment ſhews the weight of the air to be ſenſible." M. *Paſchal.* NAT. HIST.

To find the conſiſtence of the air. Experiment 1.

A thin large bladder, wherein remained only a third of the air, 'twas capable of containing, firmly tied at the neck, ſuſpended thereat, and fixed, by its lower end, to a fourteen pound weight that reſted on the floor, but ſo, that the ſtrings employed being well ſtretched beforehand, would, if contracted even leſs than the quarter of an inch, draw up the ſame; we placed fire at ſome diſtance therefrom, by means whereof the air expanded, ſwell'd the bladder, ſhortened the whole ſtring, raiſed the weight, and made it ſwing like a pendulum. We attempted twice or thrice to repeat the experiment with a quarter of a hundred weight, and a large bladder, but did not ſucceed; the bladder either ſoon leaking or burſting; tho' we proceeded ſo far, in one of theſe trials, as to gain hopes of thus ſuſtaining a large weight.

Experiment 2. In order to find whether the particles of the air would ſink into a liquor expoſed to its natural preſſure, we ſtrewed copper filings over the bottom of a cylindrical vial, and poured thereon an urinous ſpirit to a conſiderable height; covering the ſurface of the liquor with oil of almonds, to the thickneſs of the fifth of an inch; when the vial was cloſe ſtopped up, and left in a quiet place for ſeveral days: during which the urinous ſpirit firſt ſlowly acquired, and then as ſlowly loſt a blue tincture. When this colour was almoſt gone, we unſtopped the vial, and kept it ſo for a minute, and then cloſed it again; when the upper part of the ſpirit began to be tinged blue, and within an hour after, tho' the veſſel during that time was ſtopped, a ſky-colour reach'd to the lower part of the fluid, and which, at preſent, is wholly blue; the oil at the top remaining clear.

The heat and coldneſs of the air. The beſt informations, I could any ways gain, have inclined me to think, that the common ſchool-doctrine about the limits and temper of three regions in the air, however plauſible, wants a juſt foundation. A phyſician, who lately came from *Morocco*, told me, that, notwithſtanding the exceſſive heat in the day-time, the nights and the air upon the mountains, were there exceeding cold. Another gentleman, who made ſome ſtay at *Guinea*, aſſured me, tho' the heat of the climate be prodigious, he frequently, about four a clock in the morning was ready to ſhake with cold, in his hammock, for an hour together. A learned perſon, who lived at *Jamaica*, informed me, that, lying in his hammock, three or four feet from the ground, with many clothes underneath, but few to cover him, he felt it cold below, and hot above. 'Tis obvious, that the heat of our air in ſummer has conſiderable effects on liquors, and the fluids of animals and vegetables; but that it ſhou'd, in the ſhade, ſenſibly rarify and expand ſo compact a body as glaſs, ſeems almoſt incredible; yet this effect appears probable from glaſſes well fitted with ground ſtopples of the ſame material, which are eaſily open'd in the colder ſeaſons; but in the hot ones, I have found the ſtrength of a man inſufficient for that pur-

NAT. HIST. poſe; ſo that I have been frequently obliged to plunge the necks of ſuch vials in cold water, that the glaſs might ſhrink, and allow the ſtopples to be disjoin'd.

The effects of the ſummer's heat, tho' uſually attributed to the bare warmth of the air, and the agitations thereby produced in our bodies, may, perhaps, ſometimes proceed from the effluvia it excites in unregarded ſubſtances. To illuſtrate and confirm this aſſertion, I might alledge the placing of a large piece of fine amber, on a ſummer's day, when the ſun was a conſiderable height above the horizon, in the ſhaded part of a window, and there permitting it to remain for ſome time, I could find no ſigns of an attractive power therein; but upon removing it to a part of the ſame window whereto the ſun's rays had free acceſs, it preſently emitted effluvia, and readily attracted thoſe lighter bodies it would not ſtir before: but this faculty it ſoon loſt, by placing it again in the ſhaded part of the window.

The governor of *Hudſon's Bay* inform'd me, that when the ſailors come within a certain diſtance of floating iſlands of ice, and the wind blows therefrom towards the ſhip, they know, by the greater degree of cold they feel, that ſuch ice lies to the windward of them; and ſometimes before 'tis viſible, or whilſt 'tis diſtant about fifteen miles from the ſhip. The wind, he obſerved, at ſuch times, uſually brings a fog along with it; which, he ſuppoſed, comes from the ice. The ſame gentleman ſaid, that where he winter'd in *Hudſon's Bay*, the rivers began to freeze about the beginning of *November*, and were ſeldom free from ice till towards the latter end of *May*; tho' *Charleton Iſland*, lying at the bottom of the bay, has nearly the ſame latitude with *London*. It ſeems they are here obliged in the winter ſeaſon, to dig ſix feet deep in ice, to come at the unfrozen water of the rivers. Brandy frequently freezes in this country; when a fourth of it is turn'd to ice, whilſt the unfrozen part remains exceeding ſtrong and fiery. The ice, which here floats on the ſea, is freſh, and ſerves, when thawed, for common water. Laſtly, my relator added, that they often find large quantities of the liquor in cavities of the floating maſſes, made by the action of the ſun thereon. A learned traveller often obſerved, during his abode upon the *Pyrenean* mountains, that the air at the top thereof was very hot, tho' within a few hours after they would be covered with ſnow; and that too in the ſummer ſeaſon. A phyſician declared to me, that the winds he felt at *Morocco* almoſt ſtifled him, and ſeemed like ſteams coming from the mouth of an oven. The *Ruſſian* emperor's phyſician declared to me, that at *Archangel*, a northerly wind, coming from the ſea, in the winter ſeaſon, produces a thaw; but that a north-eaſt wind increaſes the froſt; and on the contrary, that a ſoutherly wind, which blows over, perhaps, a thouſand miles of frozen land, rather augments, than diminiſhes the ſame.

An inquiſitive perſon, who had alſo viſited the *Pyreneans*, declared, that both he and his company had ſometimes obſerved, from the

higher

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

NAT. HIST. of the year, the hot winds blow from the continent, the ſand on the ſhore is ſo ſcorching hot, as thro' their ſhoes to burn the feet of thoſe who ſlowly walk thereon; at which times the air ſeem'd to him hot and heavy, as if it came from an oven: and when the wind, he ſaid, blew thither from a certain wood, wherein many elephants and other wild beaſts lay dead; the air, by effluvia of their carcaſes, became intolerably fetid.

" On the top of mount *Ida* ſtands a little chapel, made up of
" looſe ſtones, which, notwithſtanding the great height of the place,
" are, ſome of them, now and then blown down by high winds.
" The air in the hotteſt part of ſummer is here exceeding cold, tho'
" not a breath of wind be ſtirring; the hills are therefore uninhabited
" both winter and ſummer; for the ſhepherds lie in the vales by
" night, where the ſummers are violent hot, whilſt the top of the
" mountain is cover'd with ſnow." *Bellonius.*

" In my aſcent to the top of mount *Venus*, the air proved very
" clear during the whole day; but when I was got up, I ſaw clouds
" under me about the middle of the mountain, which intercepted my
" view of the valleys. Coming down in the evening, I found much
" rain had that day fallen below; tho' nothing like it had happen'd
" above. 'Twas in ſummer I went up, yet perceived no great difference
" in the air all the time, as to heat and cold. *Bartholin* relates the
" ſame of the *Alps*." *Zabarell. de region. aëris.*

A phyſician told me, he ſaw mount *Atlas* from *Morocco*, cover'd with ſnow in the heat of ſummer. And the like hath been ſeverally affirm'd to me, by travellers, of the *Alps*, where the wind has been found exceeding ſharp; of the pike of *Teneriff*, of mountains in *Barbary*, in the iſland *Ceylon*, and of *Congo*; tho' ſnow be a ſtranger to the valleys hereto adjoining.

An Experiment. About midſummer 1688, I placed a thermometer in a cave, where the ſpirit ſtood half a ſmall diviſion above temperate; whilſt another in a common room was riſen to hot: in the chriſtmas following, the ſame glaſſes being ſet in their reſpective places, that in the cave ſtood as before, but that in the room, at froſt. The cave was cut ſtrait into the bottom of a clift, fronting the ſea, to the depth of 130 feet, with 80 feet of earth above it.

I am inform'd by two gentlemen of the province of new *Hampſhire* in *New-England*, that both the coldeſt wind of that country in the winter, and the hotteſt in the ſummer, is the north-weſt; which they aſcribed to the large tract of continent, and the large woods that lie to that point of the compaſs; for theſe woods, they ſaid, are laden with ſnow in the winter; and in ſummer, the cloſe air of the valleys, and the thick exhalations wherewith it is loaded, conceive an intenſe heat, and often breathe in a ſudden guſt like the ſuffocating ſteam of a furnace.

" On

" On one ſide of the mountains of *Bavaria* 'tis winter, and on the Nat. Hist.
" other ſummer, at the ſame time; ſo that while this ſide is parch'd
" with heat, that lies buried in ſnow." *Balbin. Hiſt. Bohem.*

A gentleman, who had frequently deſcended into the gold mines at *Cremmitz* in *Hungary*, told me, that in his aſcent out of one, which was an hundred feet deep, he obſerved the air about the middle to grow ſenſibly warm, and ſo to continue while he was drawn many feet higher; when at length it became cold again. This heat he ſuſpected might proceed from ſome mineral region thro' which he paſſed; for he there found himſelf ſurrounded by a vein of native vitriol of different colours, and ſoft in the pit, tho' it ſoon harden'd in the open air.

An experienced perſon, who had ſometimes croſſed the line, acquainted me, that the method of cooling liquors on board their ſhip, ſo as to make them potable in ſultry climates, was to wrap up the bottle wherein it was contain'd, in a coarſe linen cloth dipp'd in ſea-water, and thus expoſed it in a proper place, to the wind; which wou'd ſoon reduce it to the ſtate deſired: but if the bottle, ſaid he, be taken away too ſoon, as it ſometimes happen'd with us, we found, ſo much of the liquor as lay near the ſides thereof grown cool, while the more central parts continued hot.

The *Czar*'s chief phyſician inform'd me, that in the year 1664, many large tracts of dry land were ſet on fire, and miſerably waſted, by the heat of the ſun. The like, in particular, he ſaid, happen'd the laſt year at *Bearhaven* in *Norway*, where ſeveral wood-houſes were alſo conſumed. This was confirm'd to him by the governor of the place; and he himſelf ſaw the country cover'd with new graſs, in the room of what was thus deſtroy'd. A learned traveller declared to me, that the inhabitants of *Mozambique*, judged the hotteſt part of the known world, had ſhewn him ſeveral houſes which were there fired by the ſole force of the ſun. Their houſes, indeed, are built with ſtone, wherein is mixed ſomething like to *Sulphur vivum*; but I my ſelf, ſays he, have often ſeen the hollows of the ſtones ſo heated by the ſun, that muſket bullets expoſed to its direct rays therein, were by that means alone ſoon melted. He added, that great part of the heat of *Mozambique*, is owing to the ſoil, which is exceeding bare, and conſiſts of white ſand, neither ſhaded with trees, nor cover'd with graſs. Another traveller, who had been here, aſſured me, the heat of the ground was ſo violent, that he was obliged to keep in conſtant motion, to avoid burning the ſoles of his feet.

" Bridges of ſnow have been obſerved upon the *Pyreneans*, to reach
" from one rock to another, and to give paſſage to the torrents under-
" neath them. My friend ſaw one, which thus ſerves for two ſtreams;
" it was 29 furlongs in length, and as much in breadth at the top.
" Theſe bridges ſeem ſtrong enough to allow a paſſage for cannon.

" The

NAT. HIST.

" The cold was ſo exceſſive in the year 753, that it froze the *Euxine*
" ſea an hundred miles in length, as well as the neighbouring ocean,
" to the depth of 30 cubits; this happen'd too at the beginning of
" autumn." *Journal de Savans.*

In *Guinea*, as I am inform'd by one who lived there, they kept their water cool, by burying it over-night in long earthen jars, a little below the ſurface of the earth. By this means it becomes potable, with ſome tolerable coolneſs, from early in the morning, till about ten a clock, when it grows nauſeouſly hot. But in the fields, they do this as well by letting their water hang all night in calibaſhes upon the trees; eſpecially where the wind comes at them.

" We made three degrees of cold, *viz.* within doors, in the woods,
" and in the open air upon the ice. The latter was ſometimes into-
" lerable; no cloaths were proof againſt it; no motion could reſiſt it:
" 'twou'd freeze the hair on our eye-lids, and thereby deprive us of
" ſight; and wou'd, I am perſuaded, have ſtifled a man in a very few
" hours time. Our faces, or other naked part, would be daily frozen
" in the woods; tho' here the cold was leſs mortifying than on the
" ice. Two thirds of our houſes were cover'd, on the outſide with
" ſnow, and the inſide hung with iſicles. Our bed-cloaths would be
" cover'd with an hoar-froſt, tho' they ſtood near the fire. The cook's
" tubs, which were within a yard of the fire, and all day long ſup-
" plied with melted ſnow, wou'd while he ſlept but a ſingle watch,
" be ſtrongly frozen to the very bottoms; he was therefore obliged
" to water his meat in a braſs kettle, placed cloſe by the fire, where
" I have often found the ſide of the veſſel oppoſite thereto very warm,
" whilſt the other was frozen an inch deep. The ſurgeon's ſyrups, *&c.*
" notwithſtanding his utmoſt care to preſerve them, were all frozen;
" and our vinegar, oil and ſack, that ſtood in the houſe, ſhared the
" ſame fate. Both the ſea and ground continued froze till *June.*"
Captain *James.*

A gentleman, who aſcended the higheſt of the *Pyreneans*, call'd *Pic de Midi*, about the beginning of *September*, when the north ſide thereof was cover'd with ſnow, told me, that both he and his companions found the air very temperate on that part of the top where the ſun did not come; but where that had free acceſs, 'twas exceeding hot, and became offenſive thro' a tent of oil'd-cloth, which they pitch'd there. Sometimes, alſo, they felt a cool wind on the top, but a much colder at the bottom. This hill may be ſeen from *Montauban*, that is, 27 leagues.

A phyſician aſſured me, that at *Morocco* he found ſome roſin of jalap, which he carried thither from *England*, melted by the heat of the air; and that it continued impulverable whilſt he remain'd in that country; but that upon returning to *Tangier*, it became pulverable again.

From the *Relatione della Provincia di Malavar.* " Summer and Win-
" ter ſeem to meet in cape *Comorino.* Towards night, at any diſtance
from

VOL. III.

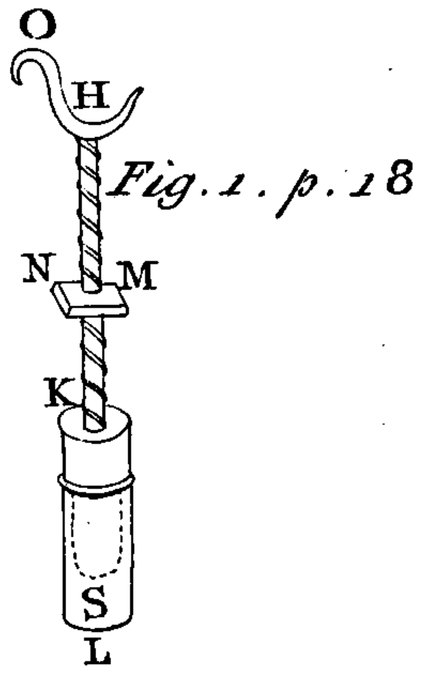


Fig. 1. p. 18

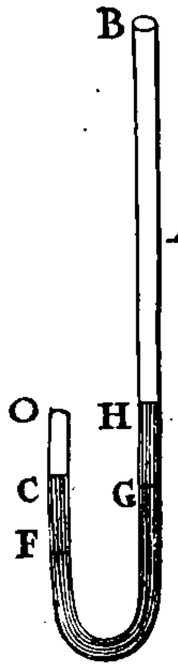


Fig. 2. p. 47.

Fig. 3. p. 48.

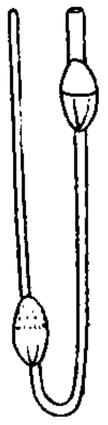
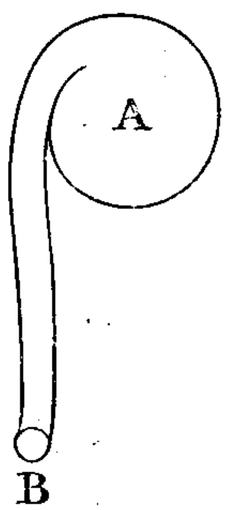
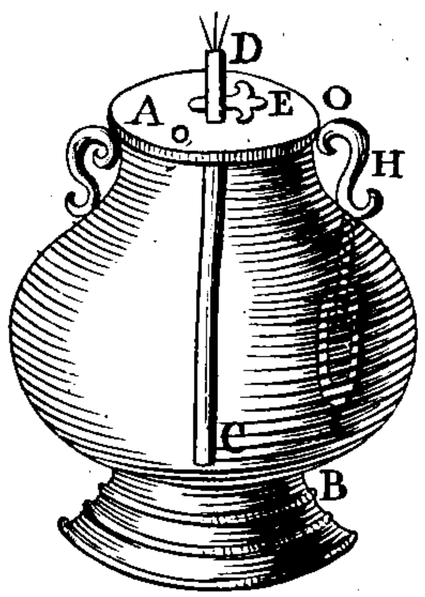


Fig. 4. p. 50.





J. Mynde

" from the cape either way, the weather and ſeaſons are found very " different, and even contrary: ſo that a perſon ſailing on this ſide " from *October* to *April*, has ſummer; and cannot in all that time " double the cape, by reaſon he there meets the winter. This the " good father who officiates in the churches of the cape finds by ex- " perience; and yet the diſtance between 'em is not above 2 or 3 miles." Nat. Hiſt.

An eminent virtuoſo, who, at *Tirol*, deſcended into a mine 1800 feet deep, declared to me, that he did not find he paſſed thro' one hot region all the way; that at the bottom he breathed very freely, by means of the air-ſhafts; and that the air there was very temperate as to heat and cold, tho' it was now the ſummer ſeaſon. Another perſon well verſed in mines, acquainted me, that the deepeſt he had been in, was a tin one of about 400 feet; which in the ſummer ſeaſon he found very cold at the bottom, and the greateſt part of the way down, without paſſing thro' any hot region; that the cold became perceptible within two fathom of the pit's mouth as he deſcended; and that both in this and many other mines, he had found a ſenſible coldneſs, before he was got a yard below that ſolid earth, whereto the roots of vegetables ſeldom reach.

From a particular relation of ſeveral merchants, who together aſcended the pike of *Teneriff*, we learn, that in their ſecond day's journey, when they were aſcended about a mile, they found it exceſſive hot; till they arrived at the foot of the pike, where it was wonderfully cold, tho' in the month of *Auguſt*; eſpecially after ſun-ſet, when it began to blow violently. In their paſſage from hence to the top they found no conſiderable alteration in the air, and very little wind; but being arrived there, the wind was very impetuous. Mr. *Sydenham* told me, that aſcending the pike of *Teneriff* on the ſouth-ſide, he found no ſnow, tho' on the north ſide there was much; that on the upper part he felt no wind; and that it was violently cold at the top.

Queries for Ruſſia.

To what depth will the ground and water freeze in hard winters?

Is the ice of *Muſcovy* conſiderably harder than that of *England*?

Will water ſpirted into the air, freeze before it falls to the ground?

Will brandy, ſack, *&c.* freeze in *Ruſſia?* Or are the inſtruments made of iron and ſteel, much more brittle there than here?

How ſtands it as to the cracking of the timber in wooden houſes? And what are the cauſes thereof?

How may fleſh, fiſh, herbs, eggs, *&c.* be preſerved in hard weather?

How are thoſe to be cured, who have any part of their body frozen?

What are the ſymptoms of being froze to death?

The air conſider'd with regard to light.

A learned traveller aſſured me, that from an elevated place on the coaſt of *Genoa*, he had frequently, both morning and evening, diſcern'd the iſland *Corſica*; but cou'd never gain ſight thereof when the ſun was near the meridian, let the air be ever ſo clear.

NAT. HIST.

King *Charles* II. did me the honour to acquaint me, that he once, from the beach near *Dover*, discover'd a new and uneven coast, in the edge of the horizon, on the other side the sea; whereat his majesty, as well as the duke of *York*, and the courtiers present, were surpriz'd; but having gazed a while thereon, it gradually disappear'd, as if it had sunk into the ocean, whence it seem'd to have sprung. This phenomenon I accounted for to his majesty, from subterraneous steams in the air, interposing between the coast of *France* and *Dover*, and causing an extraordinary refraction in the air; by means whereof the *French* coast was elevated to the eye, and so continued while that refraction lasted; but when the vapours were either raised to high, dissipated by the sun, or dispersed by the winds, the refraction ceased, and the object became invisible. This hypothesis I illustrated by the familiar experiment of a guinea and a bason of water; for that, or any other proper object, placed in the bottom of an empty bason, and render'd invisible by the interposition of the edge of the vessel, between that and the eye; if water be poured into the vessel, the guinea will then be raised to sight, tho' the eye remain unmov'd. The duke of *York* was also pleased to say, that being near the borders of *Scotland* one morning, in dull weather, and seeing the sky very red, he foretold a rainy day; but some of the *Scotch* nobility hence observed to his highness, that such a phenomenon in that country promised a fair one; and the event confirm'd it. And this observation, as I am inform'd by a nobleman of *Scotland*, commonly holds true, under due limitation; for that tho' when the redness appears near the ground, with narrow streaks of that colour in an intense degree, it signifies bad weather; yet if the morning blush be elevated in the sky, and the wind sit easterly, the day proves, generally, fair.

" I made some observations upon the rising and setting of the sun,
" by means of very exact running glasses; for our clock and watch
" were both so frozen, tho' constantly kept wrapt up in cloaths, and
" placed in a chest, by the fire-side, that they wou'd not move. I
" compared my observations made by these glasses, with the stars
" coming to the meridian; and thus found the sun rose 20 minutes
" too soon, and set as much too late; which proceeded from the re-
" fraction of the air.

" One evening in *March*, the moon rose, in a very long oval, along
" the horizon. The weather continued extreme to the 15th of *April*,
" when our spring was frozen harder than it had been before in that
" year. When the sun shone with the greatest purity of air imagin-
" able, we cou'd not gain sight of a small island four leagues distant
" from us; but when the weather proved misty, 'twas frequently
" visible, even from the lowest ground. I took its height instrumen-
" tally from the sea-side, and found it 34 minutes, when the sun was
" elevated 28 degrees. This shews how great a refraction here is;
" by means whereof I have found the land raised to the sight, tho'

" the

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Continue

NAT. HIST. continue long; for when the ſun's rays became more direct and ſtrong, they ſoon confounded this airy phantom, or mock-city.

"Moiſt vapours are not the only cauſe or ſign of the air's opacity; "for that dry blighting eaſt-wind, call'd by the huſbandmen a red "wind, renders it at a diſtance thick and bluiſh. This is the wind "which for the two laſt years has proved ſo pernicious to all ſorts of "trees, as not only to blaſt the fruit, but the very leaves thereof in "the tender." That the air is ſometimes clear and tranſparent, and at others darken'd and clogg'd by terreſtrial ſteams, need not be ſaid; but there are other phenomena of that fluid, depending upon its denſity, tranſparency, *&c.* which paſs unobſerved by the vulgar, and require ſkill in the doctrine of refraction to underſtand; on which, therefore, I ſhall not now inſiſt. There are alſo others no leſs worthy of our notice. By comparing the different accounts of eminent authors, as to the number of the fixt ſtars, with ſome obſervations of my own; I was induced to ſuſpect the ſeveral conſtitutions of the air might occaſion ſome variations herein. And, upon enquiry, I learnt that celeſtial obſervations are moſt ſucceſsfully made, where the air is pureſt; but particularly, I ſuſpected, that intenſe cold, by precipitating the vapours of the air, wou'd render it fit for this purpoſe. To confirm this conjecture, an ingenious phyſician told me, that travelling one night in *Ruſſia*, whilſt the weather was exceſſive cold, both he and his fellow-travellers ſtopp'd, to contemplate the unuſual brightneſs, and immenſe number of the ſtars, beyond what they had ever till then beheld.

"*Charlton Iſland*, *January* 30 and 31. In the beginning of the night, "there appear'd more ſtars by two thirds than ever I ſaw before. "The cloud in cancer was full of ſmall ſtars; and a great many ap-"pear'd among the *Pleiades*. About ten a clock the moon roſe, when "a quarter of them became inviſible. The wind, for the greateſt "part of this month, has ſtood northerly, and blown very cold." Captain *James*.

The *Ruſſian* emperor's phyſician aſſured me, that one night, when 'twas prodigiouſly cold and clear, he obſerved more ſtars than ever he had ſeen in *England*, or the neighbouring parts of *Europe*; particularly ſeveral about the *Pleiades*, and abundance of new ones in other parts of the ſky; and that they appear'd by far more bright and beautiful than uſual. Thoſe who travell'd with him, he ſaid, alſo made the ſame obſervation.

"On the 29th of *November*, paſt 11 at night, I ſaw a light in the "north-eaſt, along the horizon, like the day break; when looking due "north, I beheld ſeveral ſtreaks of light, reſembling the tail of a "blazing ſtar, that all pointed north and ſouth; one whereof was "longer than what we ſaw the laſt year, for it reach'd from the "horizon to the zenith; paſſing between *Charles*'s wain, and the north "ſtar. The ſmall ones ſometimes diſappear'd, and others of the

" ſame magnitude appeared in their places, but all near the great one; NAT. HIST.
" two of them ſeemed to come from the two guards in *Charles*'s
" wain, and when theſe vaniſhed, others aroſe more to the ſouth.
" This light extended from W. N. W. to E. N. E. About the
" time of the laſt new moon ſuch another phenomenon was ſeen by
" the Lord *Belcarus*, as he came, by night, from *St. Andrews*, by the
" ſailors of the yacht at *Leith*, and by ſome perſons in this town: And
" tho' the ſky was not then clear, yet it gave a light ſufficient to
" read by. It began, they told me, about ſeven, and continued till
" nine. Theſe phenomena are ſurprizing to us who are ſtrangers here,
" but the natives ſay, they frequently happen." * This account came from his royal highneſs the duke of *York*, then high commiſſioner in *Scotland*.

The effects of the air on ſeveral bodies.

The generality of men are ſo accuſtomed to judge of things by their ſenſes, that becauſe the air is inviſible, they aſcribe, but little to it, and think it but one remove from nothing. And this fluid is even by the ſchool-men, conſider'd only as a receptacle of viſible bodies, without exerting any action upon them, unleſs by its manifeſt qualities, heat and moiſture; tho' for my part, I allow it other faculties, and among them, ſuch as are generative, maturative, and corruptive; and that too in reſpect not only of animals and bodies of a light texture, but even of ſalts and minerals. An intelligent perſon, who had often ſailed from *Europe* to the *Eaſt-Indies*, told me, they included their thick *Cheſhire* cheeſes in proper leaden boxes, and by that means preſerv'd them ſound, during the whole voyage; but that when ſuch a method was not made uſe of, upon cutting one near the equinoctial, the greateſt part of it would be very dry, brittle, and ſeem ſpoiled, while the central parts remain'd fat and ſoft; as if the moiſture of the whole cheeſe had retir'd thither: for if the ſame thing were done when they were come from the torrid into the temperate zone, the external portion would be good, and the cheeſe return to an uniform conſiſtence.

" *Query*. Are not the moiſt particles, which float in the air, the
" cauſe of all corruption in bodies; ſince, according to *Acoſta*, every
" thing in *Peru*, (and the ſame is obſerved of *Egypt*) where it ſeldom
" rains, continues long uncorrupted? or is this reſiſtance of putrefaction
" rather owing to the nitrous ſalt wherewith the air of thoſe countries
" abounds?"

A man of learning, who had often croſſed the line, in *Portugueze* ſhips, told me, that upon their near approach thereto, he obſerved a great

* The like phenomena have of late been frequently obſerved in ſeveral other parts of *Europe*; and particular accounts are given of them in the *Philoſophical Tranſactions* and the *French Memoirs*. Mr. *Whiſton* alſo publiſhed a ſmall treatiſe upon that remarkable *Aurora Borealis*, which appeared *March* 6. 1715-6. But the phyſical cauſe of theſe lights has hitherto been only gueſſed at. See *Philoſoph. Tranſact.* N° 310, 347, 376, &c.

change

NAT. HIST. change in the consistence of their bisket, and that most of their provision, and even their salt-fish, was so damaged thereby, as to be scarce edible. He added, that their pilot, who had been above twenty several times in the *Indies*, assured him, their fresh water was never thick or fetid under the equinoctial; but always as if newly put into the cask.

Dr. *Stubbs* assured me, that the silks brought to *Jamaica*, will, if there exposed to the air, rot even whilst they preserve their colour; but if kept therefrom, both hold their strength and die.

An experiment. Upon opening a small glass receiver, wherein half a lemmon and a mercurial gage had been included for above three years, we found the fruit had preserved both its form and colour; the upper part of the pulp was, indeed, depressed, and seemed to be dried, but the juice there wanting, appeared upon the glass-plate, whereto the receiver was ground and fitted; which being separated, a large quantity of external air rush'd impetuously into the receiver. Neither the lemmon, nor its lost juice, had acquired any ill scent, or the least signs of putrefaction or mouldiness; whence I conjecture, as mould appears thro' a microscope, to be a vegetable, it requires the assistance of the air to its production. The juice was clear and without feces, in colour between brown and reddish; its taste was acid, and it turned the syrup of violets purblish, and immediately corroded small pieces of coral without the assistance of heat.

A scholar told me, that as he several times sailed near the line, he found some lozenges, which he usually carried in his pocket, quite dissolved; tho' they never lost their consistence in any other part, nor continued fluid when he was got a few degrees beyond the equator.

A gentleman of *Sweden*, who dealt in the metals of that country, inform'd me, 'twas the practice, in the principal copper mines they had, to make use not of iron chains, as in other mines, to draw up their oar with, but to fasten their baskets to ropes, prepared of ox-hides; because the links of iron, they found, were very subject to break, when loaded in hard winter weather. The master of a glass-house informed me, that well neal'd glass-metal would, sometimes, break of it self, with violence, long after 'twas made; and that, in particular, having, once set by a large parcel of glasses, for half a year, he found, at the end of that time, a fourth part of them spontaneously broken; the cracks generally proceeding from some of the salt not sufficiently comminuted, which appeared like small stones therein. And a learned gentleman, the owner of an iron mine, informed me, that at his house in *Suffolk*, which stands within six miles of the sea, and has been built but 80 years, the iron bars of the windows, looking southward to the salt-water, are so swelled, rotten, and brittle, as to be easily pulverable. He farther said, that several iron bars of his, lying near the sea-shore, were accidentally drench'd, for some hours, in the salt-water; whence they

they eaſily yielded thick flakes of ruſt when they came to be ham- NAT. HIST.
mered.

An experienc'd maſon told me, that *Salisbury* cathedral is built of *Purbeck* ſtone, which gradually becomes ſofter, and moulders away in the air; that the ſame is obſerved of ſome *Blechington* ſtone, tho' kept from the wet; but that what comes from *Painſwick*, within four miles of *Glouceſter*, tho' ſoft and friable at the firſt, will, by lying in the air, acquire an hard, yellowiſh, glaſſy cruſt, like marble; which grows the faſter for being often waſh'd, but reaches very little below the external ſurface.

Air conſidered with regard to flame.

I am informed, that candles will, ſometimes, continue burning in grooves, unfurniſhed with air-ſhafts, at the depth of ten fathom; but that when they come into cloſe ground, the duſt, raiſed by the workmen, (eſpecially if the ſtone be full of mundic) will extinguiſh them, unleſs freſh air be convey'd into the pit.

Experiments to be made.

To burn candles, ſpirit of wine, match, touch-wood, ſpunk, &c. under a glaſs bell; and to keep animals therein, whilſt the flame continues. To burn bodies to aſhes, in ſealed glaſſes. To do the ſame in cloſe receivers. To burn cotton in a ſealed glaſs. To make a mixture of flames, under water, in an exhauſted receiver. To burn ſpirit of wine, and oil of turpentine, in glaſs veſſels with ſlender necks. To make experiments by burning of gun-powder; and by trying to fire a piſtol in an exhauſted receiver. To burn ſaline ſubſtances in an exhauſted receiver. To burn mixtures made with ſalt-petre in exhauſted receivers. *

An experiment to ſhew the effect of air in fermentation.

Having put a ſmall handful of raſins into a bolt-head, half fill'd with water, we exhauſted the air therefrom, and placed the containing receiver in a digeſting furnace, to forward the fermentation; the ſeaſon being then cold. After a while the raiſins emerged and floated, for ſome days, on the top of the water, when moſt of them appeared ſurrounded with numerous bubbles, and but very few of them ſubſided; tho' the number of bubbles afterwards decreaſed daily, and a ſediment appeared at the bottom of the glaſs. In a fortnight after this experiment was begun, the upper part of the glaſs being accidentally broke, while I ſtood by it, the external air ruſh'd violently thereinto; and I perceived the ſurface of the liquor overſpread with bubbles, reſembling the froth of bottled beer. There alſo ſeemed to iſſue from the broken apex, a viſible fume of a languid ſcent. The liquor was highly tingled with the raiſins, and ſeemed to have gained a thicker conſiſtence than that of water.

* It appears from ſome experiments made by Mr. *Hauksbee*, that the air paſſed thro' red hot metals or charcoal, and reſpired by animals, is ſudden death; and that it inſtantly extinguiſhes the flame of a candle; tho' the air, by this management, loſes nothing of its ſpring or ſpecific gravity; but if paſſed thro' a red hot glaſs-tube, or metals, with no greater heat than that of boiling water, it ſeems to have no ſuch pernicious effect. *Hauksbee*'s Experim. pag. 282---288.

Upon

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The operation of the air on the odours and taſtes of bodies.

Experiment 1. Upon opening an exhauſted receiver, wherein a large quantity of verjuice with green, ſour grapes, had lain included for three years, there appeared no mouldineſs any where; only the ſurfaces of the uppermoſt ſkins were a little diſcoloured with ſomething, which by its taſte, and appearance, thro' a microſcope, I ſuſpected to be a kind of tartar. The liquor they had afforded was acid upon the tongue, and would diſſolve coral without heat; but the ſkins had a muſty ſcent. The mercurial gage ſhut up along with the verjuice, ſhew'd ſcarce any air to have been produced therein, during all this time.

The lord *Sandwich*, and two gentlemen of his retinue, aſſured me, that the common report as to their having no neceſſary houſes at *Madrid* was true; and that tho' they always make a jakes of their ſtreets over night, 'tis not eaſily diſcoverable by the ſcent the next morning. *Madrid*, however, his lordſhip ſaid, had a more offenſive ſcent than any city he knew; but they all three agreed, that the place wherein the ambaſſador's family conſtantly made water, had no ſcent of urine, and that they frequently obſerved both the dogs and cats, which lay dead in the ſtreets, afforded no offenſive ſmell.

Experiment 2. Upon opening another exhauſted receiver, wherein, for above three years, ſome large pieces of oranges had been included, we found their rind changed almoſt black, ſcarce any liquor afforded, no putrid ſcent, nor the leaſt mouldineſs upon any of them.

I learnt from Mr. *Nickſon*, that they preſerved beef without ſalting it, during all the time the froſt laſted, that is, the whole winter; but that when once thoroughly frozen, 'twould never, tho' well dreſs'd, have its natural reliſh.

Upon their colours and texture.

A learned man acquainted me, that he found the air of *Braſil* had a great influence upon the colours of cloaths, and even upon black; ſo that the ſable taffaty, which is there worn by the higher rank, will, in a few days, become of an iron colour; tho' when kept cloſe in the ſhops, it preſerves its proper hue. He alſo informed me, that at a place 50 leagues beyond *Parigna*, white people ſoon grow tawny; and as ſoon recover their native colour, by removing out of that quarter. The ſame gentleman further ſaid, that upon *Charlton Iſland*, there are birds reſembling our wild pigeons, but called by the *Engliſh* partridges; which appear white in winter, and grey in ſummer. The phyſician to the governor of *Jamaica* told me, that *Lignum vitæ*, and moſt other trees in that country, when freſh cut down, wou'd ſoon grow green on the new made ſurface, if that were expoſed to the air, while the parts immediately below it remain yellow; and that *Guaiacum* is ſoft whilſt growing, but when fell'd acquires ſuch a hardneſs in the air, that an ordinary tool will not touch it. Several other trees, he ſaid, had there the ſame property; but particularly the cabbage tree; the pith whereof will ſoon rot of it ſelf, and leave a large, hollow pipe, perhaps an hundred feet in length; which, inſtead of corrupting, grows almoſt as hard as iron, in the ground. A curious

rious traveller informed me, that having gathered ſome of the aloes plant, which grows plentifully in the iſland of St. *Jago*, the juice whereof is not only exceeding glutinous and bitter, but of a very dark colour, and carried it towards the equinoctial, he there found the juice loſt its bitterneſs for a ſeaſon, and became green. NAT. HIST.

Stains cauſed by vegetable juices, are beſt taken out of linen at that time, when the ſeveral plants which afford them are in their prime. This one lady has experienced in new linen ſtain'd by the juice of quinces; and another in ſome diſcolour'd by the juice of hopps, which ſhe thinks makes the worſt of ſtains; but having long tried in vain to fetch this out, ſhe lock'd up the linen in a cheſt till the ſeaſon of hopps came on, when the ſpots thereof vaniſhed of themſelves.

Having mixed one part of *Lapis Calaminaris* in powder, with four parts of fine ſalt-petre, we kept them for ſome hours in a ſtrong crucible and a vehement fire, till the ſtone was prepared; whereupon we afterwards poured a proper quantity of fair water, which afforded an untranſparent ſolution of a deep red colour. This we put up into a wide-mouth'd glaſs, and ſuffer'd it to ſtand in a ſouth window expoſed to the open air; where, in a ſhort time, it became quite green, and leſs turbid than before; and continuing here for ſome days longer, its green colour vaniſh'd by degrees, and the liquor appear'd tranſparent; letting fall to the bottom a red powder like brickduſt. The ſame changes happen'd in more than one parcel of this ſolution. *Experiment* 1.

Upon boiling ſtrong ſpirit of vinegar for a while with crude filings of copper, 'twas not apparently coloured thereby; nor even after it had ſtood for ſome hours in the glaſs egg wherein it was boil'd; we therefore poured them both together into a broad flat glaſs, and ſet it ſhelving in a widow, that only one part of the filings might lie buried in the menſtruum. So much of the metal as was thus immediately expoſed to the air, became of a greeniſh blue; whilſt that cover'd by the liquor, held its own colour, till by gradually evaporating the menſtruum, it came to touch the open air, upon which it acquired the ſame colour with the former. *Experiment* 2.

We put one parcel of copper filings into a flat, ſhallow, wide-mouth'd glaſs, and another into a common vial; then pouring upon each a proper quantity of ſal-armoniac diſſolved in fair water, we let the veſſels ſtand together, uncover'd, for a conſiderable time; at the end whereof we found, as we expected, the liquor in the cloſer glaſs faintly tinged, while that in the more open one, was very deeply coloured. 'Tis remarkable here, that tho' the lower part of the ſolution appear'd of a deep, ultramarine blue; the upper ſurface was cover'd with a film, like thin ice, which in colour reſembled a fine turquoiſe. *Experiment* 3.

Two ſmall parcels of copper filings being laid upon paper coffins, we added to each of them three drops of ſpirit of ſal-armoniac; then leaving one of them in a window, we placed the other in a receiver, which was immediately afterwards exhauſted by the air-pump. Two *Experiment* 4.

NAT. HIST. minutes had not paſſed from the dropping on of the ſpirit, before a manifeſt blue appear'd on ſome parts of the paper left in the window; but that in the exhauſted receiver continued colourleſs for a full quarter of an hour; when, taking off the glaſs, and removing this paper to the other, in about two minutes, it diſcovered a blueneſs, which, in two more, grew conſiderably deep.

Experiment 5. By dropping ſome copper filings into a ſlender vial, containing a proper quantity of the urinous ſpirit of wine lees, whoſe colour is yellow, and ſtopping up the glaſs, we gain'd a tincture manifeſtly green; then ſuffering the glaſs to ſtand for ſeveral days in a window, we found the liquor ſlowly return to a yellow, and at length to loſe all its green colour; when, upon opening it to admit the air, and ſtopping it again, the ſurface of the liquor began immediately to change green; and this colour gradually ſpread downwards, till the whole was tinged: but by long ſtanding, it gradually alter'd to a pale yellow. Having preſerved ſeveral vials full of this liquor, I perceiv'd one of them, which had once loſt its colour, regain'd a fair blue by ſtanding, tho' the including glaſs remain'd conſtantly ſtopped; and tho' the liquor in the vial that ſtood next it, which was the ſame ſpirit impregnated with filings taken from the very ſame parcel, continued colourleſs. This glaſs, indeed, was only ſtopp'd with a cork, but I obſerved the ſame phenomenon in a bottle with a glaſs ſtopple: nay, I afterwards found it ſo in another, whilſt in one ſtopp'd with a cork, that ſtood by it, no colour appear'd. Theſe glaſſes were all fill'd with the ſame materials, and on the ſame day with thoſe above-mentioned; and at the time of this obſervation, made in *Auguſt*, the weather was colder than uſual. Looking alſo, about this time, upon ſome ſpirit of amber, which had for ſeveral days ſtood upon copper filings, the glaſs being ſometimes unſtopped to admit the air, I found it had gained a green colour, tho' it before obſtinately preſerved its own.

Experiment 6. A ſlender vial filled with ſpirit of honey, tho' ſubject immediately to exchange its yellow colour for a blue, by receiving the air upon its ſurface; yet being once open'd in the place where it uſed to exhibit this phenomenon, it remain'd of a tranſparent yellow, for an hour before it turn'd blue.

Experiment 7. I have obſerved a certain liquor frequently loſt and regain'd its colour, appearing ſometimes of a faint, ſometimes of a deep blue, and ſometimes colourleſs; whilſt the fluid in another vial that ſtood near the former, wou'd ſometimes correſpond therewith, and at others vary from it. The weather ſeem'd not to be the cauſe of this variation, for the liquors wou'd both acquire and loſe colour indifferently on cold days or hot.

Obſervations. A gentleman of my acquaintance told me, that in a large piece of ground in *Wales*, near a mountain famed for the thing, he ſaw abundance of hard ſtones like flints, ſome of a dark colour, and others grey, which when newly turn'd up in tilling, appear'd of a ruſt-colour, but afterwards grew

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

NAT. HIST. common water: when admitting the external air, its operation was ſcarce ſenſible for ſome time; but within 24 hours the menſtruum had acquired a faint, and moderately tranſparent green. So that this tinged liquor, as it very ſlowly loſt, ſo it ſlowly and imperfectly recover'd its colour.

Experiment 12. Upon filings of copper, in a vial that wou'd contain 2 or 3 ounces of water, we poured ſtrong ſpirit of ſal-armoniac, made without quick-lime, to near an inch above them. This was done *Auguſt* the 20th, on *Friday* before noon; and by the following *Monday* in the afternoon, it had acquired a deep blue tincture, and loſt it again ſo far, that 'twas almoſt pale like common water. Then I unſtopp'd the vial, and in a minute or leſs, the ſurface of the liquor acquired a deep blue colour, that reach'd conſiderably downwards; the whole quantity becoming, in 4 or 5 minutes more, of the like colour: and the glaſs being preſently ſtopp'd, and left in the ſame place, appeared not at the end of nine days to have loſt its tincture; tho' now and then, within that time, it ſeem'd manifeſtly paler than when we ſtopp'd up the vial.

Leſs obvious qualities introduced into bodies by the air.

A gentleman, who reſided for a year in *Guinea*, found, as did others, alſo, of his company, the heat and moiſture of the air ſo favourable to putrefaction, that their white ſugar would, ſometimes, be full of maggots; that ſeveral drugs, plaiſters, *&c.* quite loſt their virtue; and that ſome of them, eſpecially their unguents, were verminous. He ſaid farther, that in the iſland of St. *Jago*, they were obliged to expoſe their ſweetmeats to the heat of the ſun; and thereby exhale the moiſture they contracted in the night, which would otherwiſe cauſe them to putrefy.

" *Oxford*, tho' ſeated chiefly on a gravelly hill, has been found " very diſagreeable to ſome hypochondriacal and valetudinary perſons, " eſpecially in the ſpring; I, therefore, ſuppoſe the air of that place " to be generally moiſt."

Air too dry, tho' ſufficiently hot, is unfavourable to the production of ſeveral inſects. I have obſerved in theſe two laſt dry ſprings, that no ſoft garden-ſnails were to be found; and that very few fleas infeſted the houſes, for want of moiſt vapours to nouriſh them; but in wet ſummers, ſnails, fleas, gnats, *&c.* appear in abundance.

" *Antimonium diaphoreticum*, whether prepared with nitre alone, or " an addition of tartar, will, in time, if it be expoſed to the air, " gain a noxious quality; and upon being taken, occaſion fainting, " vomiting, *&c.* but this effect is eaſily prevented by exhibiting the " medicine freſh prepared; or when kept too long, by committing " it alone to the fire for an hour or two, or if freſh nitre be added, " by edulcorating, and a little reverberating the preparation." *Zwelfer.*

A phyſician of the college at *London* aſſured me, from his own obſervation, that *Antimonium diaphoreticum*, having been kept for ſome years, tho' in a cloſe veſſel, acquired an emetic quality. Ceruſe of antimony, tho' it ſtood in a ſtopped glaſs, he alſo found did the ſame; fifteen

fifteen grains whereof he had given for a doſe, without the leaſt inconvenience, when the preparation was freſh; but after it was ſtale, four or five grains of it would vomit. NAT. HIST.

" If ſome *Egyptian* earth be taken up near the river, and carefully " preſerved from wet and waſte, 'twill be found, if duly examined " by the balance, neither to increaſe nor diminiſh its weight till the " 17th of *June*; when it will begin to grow heavier, and continues to " do ſo as the river fills; whence they certainly know the ſtate of the " deluge, which, doubtleſs, proceeds from the moiſture of the air." *Proſper Alpinus*, *Joh. Varot*, &c.

Earth, thrown on a heap, and ſuffered to lye for five or ſix years in the air, makes better pots for cloſeneſs and bearing the fire, than what has only lain one ſeaſon above ground; tho' this be preferable to that which is newly dug; as being not ſo apt to crack in the fire, or by wet. Such bricks, alſo, as lye near the top of the kiln, in burning, are apt to fail, when they come to be expoſed to the weather.

Air, as it regards vegetation, generation, life and death.

'Tis a common obſervation, the difference there is between the two ſides of the *Pyreneans*, that which looks to *France*, and that which reaches to *Spain*; the former being verdant and flouriſhing, whilſt the other is ſcorch'd and barren. This ſeems owing to the parching winds, which are, ſometimes, blaſting, and beat upon the *Spaniſh* ſide of the mountains; whereby the other is ſkreen'd, and enjoys all the advantages of the ſoil and climate.

" As to life and death, with the conſiderations thereto belonging, " we have already ſpoke to them; in like manner, alſo, not only " phyſicians, but philoſophers, have a right to diſcourſe of the cauſes " of health and diſeaſes; for as thoſe phyſicians, who have any tin- " cture of accuracy and elegance, derive the principles of their art " from nature, ſo all accurate philoſophers trace nature up to phy- " ſic." *Ariſtot.*

The temper of the air may, univerſally, be derived from the ſubterraneous vapours and ſuperficial effluvia of the earth, variouſly tranſpoſed, blended, and compounded by the winds, and other motions; and, probably, upon the different mixtures hereof all the local qualities of that fluid depend. A phyſician acquainted me, that about three months before the laſt great plague in *London*, he was conſulted by a man, who complain'd of a ſwelling in his groin, and thereupon confidently aſſerted, that the plague would rage dreadfully, during the following ſummer, in the ſame city: his reaſon was, that having once had a peſtilential tumour, in a former great plague-ſeaſon, two other leſs violent plagues were, ſeverally, preceeded by a leſs degree of the ſame ſymptom in himſelf

The bare local motion of the air may, in particular caſes, operate upon bodies, either by being changed into wind, modified into ſound, or diſorder'd by thunder. 'Tis evident, that according to the vehe-

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mence or ſlackneſs of the wind, and the places from whence, and to what quarter it happens to blow, various effects enſue, eſpecially in animate bodies; and this not only as it is attended by cold and heat, moiſture and dryneſs; but conſider'd as an aerial ſtream, whereby it fans the places through which it paſſes, expels the ſtagnant air, and introduces freſh; hence it, doubtleſs, may contribute to many changes in the health of animals, but more eſpecially in the tender ſort of them. I was informed, in *Languedoc*, that if thunder happens there, after the ſilk-worms had eat their fill, and began to diſpoſe themſelves to ſpin, a great part of them would be deſtroy'd.

Upon letting horſes down, a third of the way, into mines of a thouſand feet deep, one told me, ſeveral of them died; but that others ſurvived, and work'd the engines there, without any ſenſible inconvenience in reſpiration; tho' the places they moved in, were ſupplied with air, only by the groove through which they deſcended, and one moderate ſhaft.

A curious traveller, who had viſited the mines of ſeveral countries, told me, that the deepeſt he had ſeen was in *Bohemia*, ſunk about two thouſand *Engliſh* feet.

The *Engliſh* conſul at *Tripoli*, and ſome time governor of the coaſt-caſtle belonging to the *Engliſh African* company, informed me, that the air in thoſe parts was not conſtantly hurtful, but frequently became ſo, when many of his men, who were before healthy, would ſuddenly fall ſick together, eſpecially of fevers and fluxes, which uſually killed them in eight and forty hours time.

The *Ruſſian* emperor's phyſician aſſured me, that once, when the froſt was very great in their country, and the wind at north-eaſt, if that blew againſt his face in walking, he was unable to breathe; ſo great a ſtiffneſs was thereby cauſed in the organs ſerving to that purpoſe; whence he was obliged to turn his head from the wind before he could reſpire.

An obſerving perſon informed me, that when the ſhip, he ſailed in, came under the line, he perceived the lice left the bodies of the *Engliſh* that were on board, and got wholly into their heads, from whence they deſcended again, ſome time after they had paſſed the equator. Another acquaintance of mine, who frequently croſſed the line in *Portugueze* ſhips, which uſually go crowded with people to the *Eaſt-Indies*, declared, that he carefully obſerved their ſwarms of lice died away upon paſſing the equinoctial; tho' that vermin grew troubleſome again ſoon after.

The duke of *York* obſerved, during his ſtay in *Scotland*, that agues, at the ſame time they were very frequent here, ſcarce appeared in that country. A *Scotch* nobleman afterwards confirm'd the ſame, eſpecially of quartan agues; adding, that 'twas once thought very ſtrange when a certain gentleman happened there to fall ſick of one; and that quar-

quartans, which are frequently brought from *England* to *Edinburgh*, are usually cured by any considerable stay in that city. NAT. HIST.

" The air is purify'd by destroying the cause of corruption therein; " if it be too much moisture, fire is the remedy; especially when made " of odoriferous plants, as laurel, myrtle, rosemary, *&c.* by which " means *Hippocrates* prevented the plague at *Athens*. Noxious vapours " may also be dispersed herein by the blowing of high winds. Thus " the plague was lately stopp'd at *Lisbon*, by a great storm which lasted " for three days together. The like also happen'd in *Morocco*, where " the same distemper raging very severely, was dissipated by a wind " that blew as hot as the steam of a furnace. Artificial storms may " be raised by frequently unloading great guns; but if the vapours " proceed from stagnant waters, they ought to be drain'd off the " land thro' proper canals; or frequently renew'd, by bringing a " river to pass thorough them. Thus the great duke of *Tuscany* has " render'd the air of his city wholesome. If dead carcases, by lying " unburied, have infected the air, deep pits should be dug to receive " them; but if filth and excrements be the cause of the plague, as " I believe it is at *Constantinople* and *Lisbon*, both the streets and houses " must be well cleansed and purified." *Roderic. Fons.*

" 'Tis remarkable, that tho' the plague rages almost every year, " round a particular place in *Gork*, where large quantities of mercury " are found; yet it never reaches that place it self. This has been con- " stantly observed by very aged men, who also received the tradition " from their ancestors." *Michael Majer.*

" Quicksilver is an alexipharmic in many distempers; and, 'tis said, " even in the plague it self (since those parts where 'tis found, remain " almost constantly free from the contagion) provided no salts or " corrosive fluids have infected that mineral, or given it a poisonous " quality."

A very ingenious physician told me, he learnt upon the island *Ternate*, that the *Dutch* having agreed with the king, to sell almost all the clove trees that grew there, in order to raise the value of their spice, such a change in the temper of the air happened thereupon, as shew'd the exhalations of the blossoms, that, when dried, afford the cloves, to be very wholesome; for soon after these fragrant trees were cut down, the whole island became exceeding sickly; which my relator imputed to the corrosive and noxious steams of a vulcano there; the ill effects whereof were formerly prevented by the aromatic effluvia of those spicy blossoms. And so remarkably was the constitution of the air alter'd, at the time he was there, that as valetudinarians, before this happen'd, usually resorted thither from *Batavia*, the *Dutch* had now, for several years, been obliged to send men, from that and other more healthy places, once in six months, to relieve their garrisons here, and carry back the sick, which were generally very numerous. A physician lately return'd from *Tangier*, told me, that tho' the place it self be healthy,

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yet ſtrangers, upon their firſt arrival, were uſually feveriſh, for many weeks; eſpecially if a ſharp continued wind blew from the eaſt.

An Experiment.

Including a few ſmall ants in a receiver, we found them very briſk and lively; but, upon drawing away the air from them, they preſently loſt their motion; but ſoon recover'd it upon re-admitting the air: when exhauſting the receiver again, the inſects lay, ſome upon their backs as dead; and thus we ſuffer'd them to remain for five or ſix hours; then letting the air into them, they continued in the ſame ſtate for above twenty minutes; but at length recovering, they ran nimbly about the glaſs, tho' it was now late in the night.

The manner of fiſhing for mother of pearl; from the *Relatione della provincia di Malavar*. "The barks intended for the fiſhery being "equipp'd, repair to the iſland of *Ceylon*, along the coaſts whereof, for "twenty miles in length, at the diſtance of two or three from land, "and the depth of 6, 8, or 10 fathom, are found immenſe quantities "of mother of pearl. The barks ſetting out in the morning with a "land wind, caſt anchor at their arrival; and the divers, whereof "each bark carries fifteen or twenty, begin to diſpoſe themſelves for "the work. In order to this, each ties a rope about his middle, one "end whereof is held by a perſon left in the bark; and with another "rope he ties a ſtone to his leg; care whereof is likewiſe taken by a "perſon in the bark. Laſtly, he girds a leathern budget before him, "and putting gloves on his hands, he precipitates himſelf into the "ſea; the others all the time giving him rope enough. Thus, by "the weight of the ſtone, he is ſunk readily to the bottom; where "untying the ſtone, he is at his liberty, and the ſtone is drawn up "again. The diver now begins with great care to rake up the mother "of pearl he meets withal, putting them up in his bag; and when-"ever he perceives himſelf begin to want breath, pulls the rope that "girds his middle, upon which he is inſtantly drawn out; when, diſ-"charging himſelf of his fiſh, he ties the ſtone again to his leg, and "dives again as before. The work is very toilſome, and even danger-"ous; the great depth of the ſea at which the mother of pearl is "found, frequently occaſioning them to be ſuffocated."

'Tis a conſtant obſervation, that if any foreigners lie all night on ſhore at *Johanna*, they ſeldom eſcape being ſick there, or ſoon after they depart; the diſtemper uſually proving putrid and mortal in two or three days; whilſt thoſe who remain all day long on the ſhore, provided they every night lie on board their ſhip, diſtant above a mile from the land, commonly remain healthy. This iſland abounds with the greateſt variety of vegetables imaginable; and 'tis here exceſſive hot in the day time, but cold after ſun-ſet: whence, poſſibly, many volatile parts of thoſe plants are gradually raiſed by day, and ſuddenly condenſed by night; and at that time taint the maſs of blood, being inſpired with the air. The inhabitants themſelves are very ſubject to fevers, for which they ſcarify their breaſt and abdomen in ſeveral places; tho' few recover, unleſs

unleſs they break out in blotches on ſeveral parts of the body. There ſtands a hill here of a remarkable height; the top whereof is almoſt conſtantly cover'd with thick fogs or clouds, which riſe higher, or ſink down lower, as the weather alters. NAT. HIST.

Upon the coaſt of *Coromandell*, and the moſt maritime parts of the *Eaſt-Indies*, there are, notwithſtanding the heat of the climate, annual fogs ſo thick, as to occaſion thoſe of other nations, which reſide there, and the more tender part of the natives, to keep their houſes cloſe ſhut up. And at *Balaſſore*, in the bay of *Bengale*, and ſeveral other parts of that country, ſo great a corruption of the air is occaſion'd by the rains which fall there, that the ſcent of it is very offenſive to the inhabitants. This, I preſume, chiefly happens from the great number of frogs, and other reptiles that are there left after an inundation, to dry and putrefy by the violent heat of the ſun. At theſe times alſo a violent ſickneſs, being chiefly feveriſh, proves very fatal to the natives.

When the *Engliſh* ſhips return from the *Eaſt-Indies*, they uſually carry their ſick on ſhore at St. *Helens*, where they commonly recover in a few days; which in all probability is owing to a change of the air, not diet; for the ſame proviſions may be had by the diſeaſed in the ſhips.

" The ſhorteſt paſſage from *Moſul* to *Bagdad*, is thro' *Meſopotamia*; " but there lies no village in the road; and, beſides, the wind *Samiel* " blows all ſummer long, from *Moſul* to *Surat*; for which reaſon tra- " vellers are obliged to go by water on the *Tigre*. The word *Samiel*, " ſignifies a poiſonous wind; which, perhaps, is the burning wind men- " tioned by *Job*. Whoever breathes herein dies upon the ſpot; tho' " ſome have firſt been heard to ſay they burnt internally. The body, " ſoon after it's dead, becomes black all over, and the fleſh eaſily ſe- " parable from the bones." *Thevenot*.

Doctor *Collins* relates, that in *Muſcovy* the horſes are very ſubject to a particular diſtemper; from which the natives uſually preſerve them by keeping goats in their ſtables; and this method the doctor himſelf was obliged to take with his own horſes.

The *Engliſh* conſul at *Smyrna* informed me, that the plague there, tho' it abates not ſo conſiderably as at *Aleppo*, towards the beginning of *July*, when the weather is exceſſive hot, yet becomes leſs mortal and in- fectious at that time; the cauſe of which phenomenon may, perhaps, be, that the peſtilential effluvia floating in the air, during the former part of the ſummer, muſt be of a particular magnitude, to exert their full force; ſo that the weather growing vehemently hot, thoſe particles are thereby diſſipated, leſſen'd in their bulk, and render'd leſs noxious. Thus the wieck of a candle juſt extinguiſh'd, proves very offenſive to the noſtrils, while the parts of the ſmoke it emits are groſs; but if that ſmoke be lighted, or rarified into flame, it ſends out particles of a quite different nature, and of an inoffenſive ſcent. It may be further ſaid, that the heat of the ſun, at times, acting powerfully, penetrates deeper into the earth, and agitates the lower parts thereof; opening its obſtruct-

NAT. HIST.

ed paſſages, and raiſing into the air various corpuſcles, to attenuate and divide the peſtilential ones; or elſe, by mixing therewith, form new concretions of a different bulk, texture, figure, or motion; and thus render the diſeaſes they produce leſs malignant, or of a different nature from the former. If the plague ſuffers this alteration only at *Smyrna* and *Aleppo*, it may be owing to the diſpoſition of the ſoil in thoſe places to emit peſtilential particles of a determined nature, by a particular degree of heat, and diſſipable by a greater, and thence to afford peculiar exhalations able to correct the former; as 'tis annually obſerved at *Grand Cairo*, that the plague, during the heat of ſummer, ceaſes to be mortal, and grows much leſs contagious, when the *Nile* begins to overflow. This ſeems occaſion'd by nitrous, or other exhalations, plentifully afforded from the arrival of freſh water; and not from the coolneſs it occaſions; ſince the plague will rage in much colder weather than can happen in *Egypt* during the month of *July*.

The air being fluid, as well as water, and impregnated with ſalts of different kinds, 'tis not improbable, that what happens in water, impregnated with ſuch ſalts, may alſo happen in the air. Two proper quantities of different ſalts being diſſolved in hot water, they floated undiſtinguiſhably therein, and retain'd a capacity to act in conjunction upon ſeveral occaſions; yet when the liquor became cold, the ſaline particles of one kind being no longer agitated by a due degree of heat, ſhot into cryſtals; and loſing their fluidity and motion, viſibly ſeparated themſelves from the other, which ſtill continued fluid in the liquor, and capable only of acting ſeparately. Hence it ſeems probable, that coldneſs and heat may, for a time, greatly alter the qualities of the air, with regard to the bodies and health of mankind. The cleareſt inſtance I have ſeen of this obſervation, was afforded me by the following experiment.

Experiments. Having diſſolved equal quantities of alum and nitre in the ſame parcel of fair water, we firſt evaporated a conſiderable part of the liquor, and then expoſed the remainder to the cold in an earthen veſſel; by which means the alum firſt coagulated at the bottom and ſides thereof, in a multitude of eight-ſided figures, whilſt no cryſtals of the nitre appeared. Upon further evaporating the liquor, and removing it from the fire, we gain'd more grains of alum, but yet no nitre; we, therefore, evaporated more of the water, till, at length, the nitre plentifully ſhot into its proper cryſtals.

A mouſe lived for ten minutes, with only a fourth of the natural quantity of the air, and three afterwards. *

The effect of rain; and a prognoſtic thereof. An eminent virtuoſo informed me, that in the country of *Campen*, he ſaw ſeveral ſhallow pits dug for peat, till they came to a kind of quick-

* Dr. *Halley* tells us, 'tis found by experiment, that a gallon of air, included in a bladder, and reciprocally inſpired and expired by means of a pipe, will become unfit for farther reſpiration in little more than a minute. *Philoſophical Tranſactions*, N°. 349. p. 492.

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SUSPICIONS
ABOUT SOME
HIDDEN QUALITIES
IN THE
AIR.

SECT. I.

BESIDES heat, cold, dryneſs, moiſture, gravity, elaſticity, the power of refracting the rays of light, *&c.* I have often ſuſpected there may be ſome more latent qualities in the air, different from theſe, and principally ariſing from the ſubſtantial parts or ingredients whereof it conſiſts. For our atmoſphere is a confuſed aggregate of effluvia from ſuch different bodies, that tho' they all agree in conſtituting, by their minuteneſs and various motions, one great maſs of fluid matter, yet, perhaps, there is not a more heterogeneous body in the world.

Subterraneous effluvia in the air.

'Tis highly probable, that beſides thoſe vapours and exhalations which, by the heat of the ſun, are elevated into the air, and there afford matter for ſome meteors, as clouds, rain, parhelions, and rainbows; there are, ſometimes, at leaſt, and in ſome places, plenty of effluvia emitted from the ſubterraneal parts of the terreſtrial globe: and 'tis no leſs probable, that in the ſubterraneal regions there may be many bodies, ſome fluid, and ſome conſiſtent, which, tho' of an operative nature, and likely, upon occaſion, to emit ſteams, ſeldom or never appear upon the ſurface of the earth; ſo that ſeveral of them have not ſo much as names aſſign'd them even by mineraliſts. Now among this multitude and variety of bodies that lie buried out of ſight, who knows but there may be many of a nature very different from thoſe we are hitherto acquainted with; and that as ſeveral

wonderful and peculiar operations of the load-ſtone, tho' a mineral, many ages ago famous among philoſophers and phyſicians, were not diſcover'd till of late; ſo there may be other ſubterraneous bodies, endued with conſiderable powers, which, to us, remain unknown; and would, if known, be found different from thoſe of the foſſils wherewith we are hitherto acquainted? NAT. HIST.

Celeſtial effluvia in the air.

Farther, the ſun and planets may have influences here below, diſtinct from their heat and light. And the ſubtile effluvia, even of theſe bodies, may reach our air, and mix with thoſe of our globe in that great receptacle of celeſtial and terreſtrial ſteams, the atmoſphere. The very ſmall knowledge we have of the ſtructure and conſtitution of globes ſo vaſtly romote from us, and our great ignorance of the nature of the particular bodies that may be preſum'd to be contain'd in thoſe globes, which, in many things, appear of kin to this we inhabit, leaves room to conjecture, that many of thoſe bodies, and their effluvia, may be of a nature quite different from thoſe we here take notice of *; and may, conſequently, operate after a very different and peculiar manner. And tho' the chief of the heterogeneous effluvia, that endure the air with ſecret qualities, may, probably, proceed from beneath the ſurface of the earth, and from the celeſtial bodies; yet at ſome times, and in ſome places, the air may derive multitudes of efficacious particles from its own operations; acting as a fluid ſubſtance upon the vaſt number and variety of bodies, which are immediately expoſed to it. For tho', by reaſon of its great thinneſs, and of its being, in its uſual ſtate, deſtitute both of taſt and ſmell, it ſeems wholly unfit to be a menſtruum; yet it may have a diſſolving, or at leaſt a conſuming power on many bodies; eſpecially ſuch as are pecu-

Effluvia from the operations of the air.

* Sir *Iſaac Newton*, after his uſual manner, has on a ſolid foundation carried this thing a ſurprizing length. "The comet, "ſays he, which appeared in the year 1680. "was not, in its perihelion, diſtant from "the ſun's body ſo much as a ſixth part of "his diameter; and conſequently, by rea"ſon of its vaſt velocity at ſo near an ap"proach, and the denſity of the ſun's at"moſphere, it muſt have ſuffered ſome re"ſiſtance and retardation, by means where"of 'twas drawn nearer to the ſun; ſo that "approaching ſtill nearer in every revolu"tion, it muſt, at length, fall into the bo"dy of him. In its aphelion, alſo, where "its motion is exceeding ſlow, it may, ſome"times be retarded by the attraction of "other comets, and afterwards fall into "the ſun. Thus alſo the fixed ſtars, which "gradually ſpend themſelves in light and "vapour, may be recruited by comets "falling into them; and being thus light"ed up again, and having new aliment "afforded them, may paſs for new ſtars. "But the vapours, which ariſe from the "ſun, the fixed ſtars, and the tails of co"mets, may, by their gravity, fall into the "atmoſpheres of the planets; and there be "condenſed and turned into water and moiſt "ſpirits, and thence gradually, by a ſlow "heat, into ſalts, ſulphurs, tinctures, mud, "clay, marl, ſand, ſtones, coral, and other "terreſtrial ſubſtances. But as the ſun's "body decreaſes, the mean motions of the "planets about the ſun will, by degrees, be "retarded; and as the earth increaſes, the "mean motion of the moon about the earth, "will be gradually accelerated: and, in"deed, Dr. *Halley*, from comparing the "*Babyloniſh* obſervations of eclipſes, with "thoſe of *Albategnius*, and the moderns, "was the firſt, that I know of, who ob"ſerved the mean motion of the moon, "compared with the diurnal motion of the "earth, to accelerate gradually." *Newton*, "*Princip. p.* 480, 481.

Nat. Hist. liarly diſpoſed to admit its operations. For the air has a great advantage, by the vaſt quantity of it that may come to work, in proportion to the bodies expoſed thereto. And in ſeveral caſes, the quantity of a menſtruum may much more conſiderably ſupply its want of ſtrength, than chymiſts ſeem commonly aware of. There are liquors too, which, tho' they paſs for inſipid, are not quite deſtitute of corpuſcles fit to act as a ſolvent; eſpecially if they have time enough to make, with the other parts of the fluid, ſuch numerous and various motions as muſt bring now ſome of them, and then others, to hit againſt the body expoſed to them. Thus we find a ruſt on copper, that has been long expoſed to the air; whoſe ſaline particles, in time, gradually faſten themſelves, in ſuch numbers, to the ſurface of the metal, as to corrode it, and produce a ſubſtance of the colour of verdigreaſe; which is a factitious body, made of the ſame metal, corroded by the ſharp corpuſcles of vinegar, or of the huſks of grapes. And by the power which mercury has to diſſolve gold and ſilver, it appears not always neceſſary, that a fluid ſolvent ſhould affect the taſt. And as to thoſe bodies on which the aerial menſtruum can operate, its immenſe quantity may bring this advantage, that tho' even the ſtrongeſt menſtrua, if they bear no great proportion, in bulk, to the bodies they are to work on, are eaſily glutted, and being unable to take up any more, leave the reſt of the body undiſſolved; this bears ſo vaſt a proportion to the bodies expoſed to it, that when one portion of it has impregnated it ſelf as much as 'tis able, there may ſtill come freſh to operate farther on the remaining part of the body.

But beſides, the ſaline and ſulphureous particles, that, at leaſt, in ſome places, may impregnate the air, and give it the greater affinity to proper chymical menſtrua, it may, merely as a fluid body, conſiſting of corpuſcles of different ſizes, and ſolidities reſtleſly and variouſly mov'd, be, upon account hereof, ſtill diſſolving, or preying upon the particles of the bodies ſubmitted to its action. For many of the aerial corpuſcles hitting or rubbing every minute againſt thoſe particles of bodies that chance to lie in their way, may well, by their numerous occurſions and attritions, ſtrike off and carry along with them now ſome, and then others of their particles; as it happens in water, which, tho' very ſoft and fluid, wears out ſuch hard and ſolid bodies as ſtones themſelves, if it often meet them in its paſſage. The aerial corpuſcles, indeed, are very minute, and the bodies expoſed to them often large, and ſeemingly ſolid; but 'tis not upon the whole body at once, that they endeavour to work, only on the ſuperficial particles, which may often be more minute than thoſe corpuſcles. Thus a lump of loaf-ſugar, or *Sal gemmæ*, being caſt into common water, tho' this liquor be inſipid, and the motions of its corpuſcles very languid, yet theſe corpuſcles are able to looſen and carry off the ſuperficial particles of the ſugar or ſalt that chance to lie in their way; and freſh corpuſcles of water ſtill ſucceeding, to work upon the re-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Nat. Hist. which I have ſeveral times actually ſeparated, or obtain'd from common vitriol, without the addition of any combuſtible body; and ſometimes without any addition at all. It was alſo uncommon, that our blackiſh minerals required no longer time, nor any rain, to make them afford their vitriolic efflorescencies; for I kept many of thoſe marcaſites, both glittering ones and others, of which they make great quantities of vitriol at *Deptford*, without perceiving in them a change, that came any thing near to what I have mentioned. And I have obſerved thoſe whoſe trade it is to make vitriol, are often oblig'd to let their vitriol-ſtones, as they call them, lie for half a year, nay, ſometimes two years, expoſed not only to the open air, but to the rain and ſun, before they can obtain from them their vitriolic parts.

That alſo the earth, or ore of alum, robb'd of its ſalt, will, in tract of time, recover it, by being expoſed to the air, we are aſſured by the experienced *Agricola*. I have likewiſe obſerved, that ſome kind of lime in old walls and moiſt places, has, in time, gain'd a large efflorescence, very much of a nitrous nature; as I was convinced, by having obtain'd ſalt-petre from it, upon barely diſſolving it in common water, and evaporating the filtred ſolution: and alſo in calcined vitriol, whoſe ſaline parts have been driven away by the violence of the fire, particles of freſh ſalt may be found, after it has lain a competent time in the air.

But tho' theſe and the like obſervations have generally paſs'd, without being call'd in queſtion; yet it ſeems to me ſomewhat doubtful, whether the ſalts that appear in the forementioned caſes, are really produced by the operation of the air working as an agent, or alſo concurring as an ingredient; or whether theſe ſaline ſubſtances proceed not from ſome internal thing, analagous to a ſeminal principle, cauſing in them a kind of maturation of ſome parts; which being once ripen'd, and perhaps aſſiſted by the moiſture of the air, diſcloſe themſelves in the form of ſaline concretions; as in the feculent or tartarous part of wines, there will, in tract of time, be generated or produced, numerous corpuſcles of a ſaline nature, that give the acid taſt we find in tartar, eſpecially in that of *Reniſh* wine. It may alſo be ſuſpected, that the ſalts found in marcaſites, in nitrous and aluminous earths, *&c.* are made by the ſaline particles of the like nature; that among multitudes of other kinds ſwim in the air, and are attracted by the ſimilar particles yet remaining in the terreſtrial bodies, which are, as it were, the wombs of ſuch minerals; as ſpirit of nitre will with fixed nitre, and ſome other alkalies, compoſe ſalt-petre; or elſe, that ſuch aerial ſalts, aſſiſted by the moiſture of the air, ſoften, open, and almoſt corrode, or diſſolve the more terreſtrial ſubſtance of theſe wombs, and thereby ſollicit and extricate the latent ſaline particles; and by their union with them, compoſe thoſe reſulting bodies that reſemble vitriol, alum, *&c.* However, if a convenient quantity of nitrous

earth,

earth, or other proper ſubſtance, be kept in a cloſe veſſel, whereto the air has no acceſs, for as long a time as has been obſerv'd ſufficient to impregnate the like ſubſtance, or a portion of the ſame matter that was included, it may help to remove our ſcruples; for if the body that was kept cloſe, have either gain'd ſalt at all, or very much leſs in proportion to its bulk, than that which was kept expoſed, we may thence learn, what is to be aſcribed to the air in the production of nitre, or other ſaline concretions. And having obſerved none of theſe bodies, that would ſo ſoon, and ſo manifeſtly even to the eye, diſcloſe a ſaline ſubſtance, as the blackiſh vitriol-ore before mentioned; I judged this a very fit ſubject, wherewith to try what maturation, or time, the air being ſecluded, wou'd do in this caſe. Accordingly, having taken ſome fragments of it, which we carefully freed from the adhering vitriolic efflorescence, we put of different ſizes of them into two conveniently ſhap'd glaſſes, which being hermetically ſealed, were order'd to be kept in fit places; by which means 'twas expected, that even, without opening the glaſſes, we ſhould be able eaſily to ſee, by the changed colour of the ſuperficial parts, whether any vitriolic efflorescence was produced; but thro' the negligence, or miſtake, of thoſe to whom the care was recommended, the experiment was never brought to an iſſue. Tho' after ſome time I perceiv'd, that notwithſtanding the glaſs had been ſo cloſely ſtopp'd, there plainly appeared on the outſide of the maſs, ſome grains of an efflorescence; whoſe colour, between blue and green, argued it to be of a vitriolic nature. But although, till the ſucceſs of ſome ſuch trial be known, I dare not confidently pronounce about the production or regeneration of ſalts, in bodies that have been robb'd of them, and aſcribe it wholly to the air; yet when I conſider the ſeveral great effects of the air upon ſeveral other bodies, I think it not taſh to conjecture, in the mean time, that the operations of the air may have a conſiderable ſhare in theſe phenomena; and ſo, that there may be latent qualities in the air; theſe qualities being underſtood *in concreto*, together with the ſubſtances, or corporeal effluvia, wherein they reſide. And of ſuch aerial qualities, taken in this ſenſe, I ſhall now proceed to mention ſome other inſtances. NAT. HIST.

A vital ſubſtance in the air.

The difficulty we find in keeping flame and fire alive, tho' but for a little time, without air, renders it ſuſpicious, that there may be diſperſed thro' the reſt of the atmoſphere, ſome odd ſubſtance, either of a ſolar, aſtral, or other foreign nature; on account whereof the air is ſo neceſſary to the ſubſtance of flame. And this neceſſity I have found to be more conſiderable, and leſs dependent upon the manifeſt attributes of the air, than is uſually obſerv'd; for by trials purpoſely made, it has appear'd, that a ſmall flame of a lamp, tho' fed perhaps with a ſubtile, thin oil, wou'd in a large glaſs-receiver expire for want of air, in a far leſs time than one wou'd believe. And it will not much leſſen the difficulty to alledge, that either the groſs fuliginous ſmoke in a cloſe veſſel ſtifled the flame, or that the preſſure of the air is requiſite to

NAT. HIST.

impel up the aliment into the wieck; for to obviate theſe objections, I have, in a large receiver, employed a very ſmall wieck, with ſuch rectified ſpirit of wine, as wou'd in the free air burn totally away; yet when a very ſmall lamp, furniſhed with ſuch a very ſlender wieck, was made to burn, and filled with this liquor, was put lighted into a large receiver, that little flame, tho' it emitted no viſible ſmoke at all, wou'd uſually expire within about one minute, and often in leſs; and this tho' the wieck was not ſo much as ſing'd by the flame: nor indeed is a wieck neceſſary for the experiment, ſince highly rectified ſpirit of wine will, in the free air, flame away without it. And it ſeems ſurprizing, what that ſhould be in the air, which enabling it to keep flame alive, does yet, by being conſum'd or deprav'd, ſo ſuddenly render the air unfit to preſerve flame. It alſo ſeems by the ſudden waſting or ſpoiling of this fine ſubſtance, whatever it be, that the bulk of it is but very ſmall in proportion to the air it impregnates with its vertue: for after the extinction of the flame, the air in the receiver was not viſibly alter'd; and, for ought I could perceive by ſeveral ways of judging, the air retained either all, or at leaſt the far greateſt part of its elaſticity; which I take to be its moſt genuine and diſtinguiſhing property. And this undeſtroy'd ſpringyneſs of the air, with the neceſſity of freſh air to the life of hot animals, ſuggeſts a great ſuſpicion of ſome vital ſubſtance, if I may ſo call it, diffuſed thro' the air; whether it be a volatile nitre, or rather, ſome anonymous ſubſtance, ſidereal or ſubterraneal; tho' not improbably of kin to that which ſeems ſo neceſſary to the maintenance of the other flames.

By keeping putrefied bodies in glaſſes hermetically ſeal'd, and thereby ſecured from the contact of the external air, I have not been able to produce any inſect, or other living creature; tho' ſometimes I have kept animal ſubſtances, and even blood, ſo included for many months; and one or two of them for a longer time; and tho' theſe ſubſtances had a manifeſt change made in their conſiſtence, whilſt they remain'd ſeal'd up. I ſhall here add another obſervation, that I met with in a little diſſertation, *de admirandis Hungariæ aquis*, written by an *Hungarian* nobleman; where ſpeaking of the native ſalt which abounds in their regions, he ſays that "in the chief mine of *Tranſylvania*, called *De-*
"*ſienſis*, there was, a few years before he wrote, a great oak, like a "huge beam, dug out of the middle of the ſalt; but tho' it was ſo "hard, that it could not eaſily be wrought upon by iron tools, yet "being expos'd to the air out of the mine, it became ſo rotten, that "in four days it was eaſily to be crumbled between the fingers." And of that corruptive, or diſſolutive power of the air near thoſe mines, the ſame author mentions other inſtances.

Seminal corpuſcles in the air.

Having found an antimonial preparation to prove emetic, in a caſe where I did not at all expect it; I enquired of ſome phyſicians and chymiſts of my acquaintance, whether they had not taken notice, that *Antimonium diaphoreticum* wou'd become vomitive, if 'twere not kept from

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NAT. HIST. of it, and gave them the true temper, which is ſomewhat different from that of other ſteel, he generally obſerved, that, tho' when razors, &c. made of it, were newly forg'd, they would be, ſometimes, worſe than thoſe of other ſteel; yet when they had been kept for a year, or two, or three in the air, tho' nothing elſe was done to improve them, they would much ſurpaſs other inſtruments of the ſame kind, and what themſelves were before; ſo that ſome of them have been laid aſide, at firſt, as no ways anſwering the great expectation conceiv'd of them, which, after two or three years, they were found to exceed. And I have ſeveral times made a ſubſtance, that conſiſts chiefly of a metalline body, and is of a texture ſo cloſe as to lie for many hours undiſſolved in a corroſive menſtruum; yet this ſubſtance, that was fixed enough to endure melting by the fire, without loſing its colour, would, when I had purpoſely expoſed it to the air, be diſſolved in a very ſhort time, and have its ſuperficial parts turn'd almoſt black.

Changes of colour introduced by the air.

And this brings to mind the very pretty obſervation, newly made in *Italy* by an ingenious man, who took notice, that, if after the opening of a vein, the blood be kept till it be concreted, and have excluded the ſuperficial ſerum, tho' the lower part be uſually of a dark and blackiſh colour, in compariſon of the ſuperficial parts, and therefore be counted far more feculent; yet if the lump or clot of blood be broken, and the internal and dark colour'd parts of it expoſed to the air, it will, after a time, be ſo wrought on thereby, that the new ſuperficial part will appear as florid as the upper part ſeemed before. And this obſervation I found to hold in the blood of ſome beaſts, whereon I tried it; but I have found it to ſucceed in much fewer minutes than the *Italian* experiment, on human blood, made me expect.

A power in the air, both of diſſolving and coagulating the ſame body.

On the other ſide, I have often prepared a ſubſtance, wherein the effect appears quite contrary to this. For tho' the factitious concrete, whilſt kept to the fire, or very carefully preſerv'd from the air, be of a red colour, almoſt like the common opake bloodſtone of the ſhops, yet if I broke it, and left the lumps in the air, it would, in a ſhort time, perhaps, in leſs than a quarter of an hour, have its ſuperficial parts turned of a very dark colour, ſometimes ſcarce at all ſhort of blackneſs.

A very inquiſitive perſon, of my acquaintance, making, by diſtillation, a medicine of his own deviſing, chanc'd to obſerve this odd property in it, that if it were kept ſtopp'd, it would be coagulated almoſt like oil of aniſeed, in cold weather; yet if the ſtopple were taken out, and acceſs for a while given to the air, it would turn to a liquor, and the veſſel being again ſtopp'd, it would, tho' more ſlowly, coagulate again. And deſiring to ſee this odd preparation, I found it, when brought into the room where I was, not liquid, but conſiſtent; tho' of a ſlight and ſoft texture. And having taken

out

out the cork, and ſet the vial in a window, tho' the ſeaſon, being winter, was cold; yet, in a little time, I found the coagulated ſubſtance almoſt become fluid. And another time, when the ſeaſon was leſs cold, being where the vial was kept well ſtopp'd, and caſting my eyes on it, I perceived the included ſubſtance to be coagulated much like oil of aniſeed. And this ſubſtance having, as the maker aſſured me, nothing at all of mineral in it, nor any chymical ſalt; but conſiſting only of two ſimple bodies, the one a vegetable, and the other an animal ſubſtance, diſtill'd together; theſe contrary effects of the air, (which ſeems to have a power, in ſome circumſtances, to coagulate ſuch a body, and yet to diſſolve and make it fluid, when freſh parts are allow'd acceſs) may deſerve to be farther reflected on, with regard to the ſeaſonable operations the inſpired air may have on the conſiſtence and motion of the circulating blood, and to the diſcharge of the fuliginous recrements to be ſeparated from it in its paſſage thro' the lungs. NAT. HIST.

There are two other phenomena which ſeem favourable to our ſuſpicion, there being anonymous ſubſtances and qualities in the air: the one is, the growth or apparent production of metals and minerals dug out of the earth, and expoſed to the air. But of this we ſhall treat more particularly hereafter; tho' the caution formerly given about the regeneration of ſalts in nitrous and other earths, may, *mutatis mutandis*, be applied to this production of metalline and mineral bodies. The other phenomenon is afforded by the various and odd contagious diſeaſes, that at ſome times, and in ſome places, invade and deſtroy numbers of beaſts, ſometimes of one particular kind, and ſometimes of another. Of this we have many inſtances in the books of approved authors, both phyſicians and others; and I have my ſelf obſerved ſome notable examples of it. Probably the ſubterraneal parts of the earth, ſometimes, eſpecially after earthquakes, ſend up into the air peculiar kinds of venomous exhalations that produce new and mortal diſeaſes, in animals of a particular ſpecies, and not in thoſe of another; and in this, or that particular place, and not elſewhere; of which we have an eminent inſtance in that odd plague, or murrain, of the year 1514; which *Fernelius* tells us, invaded none but cats. And even in animals of the ſame ſpecies, ſometimes one ſort has been incomparably more obnoxious to the plague than another. *Dionyſius Halicarnaſſus* mentions a plague that attack'd none but maids: and the peſtilence, that raged in the time of *Gentilis*, a fam'd phyſician, kill'd but few women, and ſcarce any but luſty men. *Boterus*, alſo, mentions a great plague, that aſſaulted almoſt only the younger ſorts of perſons; few paſt thirty years of age being attack'd by it; which laſt obſervation has been, alſo, made by ſeveral late phyſicians. We may add, what learned men of the faculty have noted, at ſeveral times, concerning plagues, that particularly invade thoſe of this or that nation, tho' confuſedly mix'd with other people.

Contagious diſeaſes occaſioned by the air.

NAT. HIST.

people. *Cardan* ſpeaks of a plague at *Baſil*, with which only the *Switzers*, and not the *Italians*, *French*, or *Germans*, were infected. And *Johannes Utenhovius* takes notice of a cruel plague at *Copenhagen*, which, tho' it raged among the *Danes*, ſpared the *Engliſh*, *Dutch*, and *Germans*; who freely enter'd the infected houſes, and were not careful to avoid the ſick. But I muſt not be underſtood to impute theſe effects merely to the noxious ſubterraneal fumes; for I am far from denying, that the peculiar conſtitutions of men are likely to have a great ſhare in them; yet it ſeems leſs probable, that the peſtilential venom, diffuſed thro' the air, ſhould owe its enormous and fatal efficacy to the exceſs of the manifeſt qualities of the air, than to the peculiar nature of the peſtilential poiſon breath'd from the bowels of the earth; which poiſon, when it is, by dilution, or diſſipation, enervated; or by its progreſs, paſt beyond the air we breathe in, or render'd ineffectual by ſubterraneal or other corpuſcles of a contrary quality, the plague, which it produced, either quite ceaſes, or degenerates into ſomewhat elſe. And thus, perhaps, ſome of thoſe diſeaſes, called new, which either began to appear, or raged within theſe two or three centuries, as the ſweating-ſickneſs, in the fifteenth century, the ſcurvey and the *Morbus Hungaricus*, the *Lues Moraviæ*, *Novus morbus Luneburgenſis*, and ſome others, in the laſt century, may be in part cauſed by the heterogeneous ſteams we are here conſidering.

Uſes of this doctrine of ſubterraneal and celeſtial effluvia in the air.

And now if our two ſuſpicions about ſubterraneal and ſiderial effluvia ſhall prove well grounded, they may lead us to farther thoughts about things of no mean conſequence; three of which I ſhall here mention. And 1. we may hence take occaſion to conſider, whether ſeveral changes of temperature and conſtitution in the air, both as to manifeſt and latent qualities, may not, ſometimes, be derived from the ſcarcity, or plenty, and peculiar nature of one or both of theſe ſorts of effluvia. We find, in the moſt approved writers, ſuch ſtrange phenomena to have, ſeveral times, happen'd in great plagues and contagious diſeaſes, fomented and communicated, nay, began by ſome latent peſtiferous, or other malignant conſtitution of the air, as have obliged many of the moſt learned of them to have recourſe to the immediate operation of the angels, or of the power and wrath of God himſelf; or at leaſt to ſome unaccountable influence of the ſtars. But none of theſe ſolutions ſeem preferable to what may be gather'd from our conjecture; ſince of phyſical agents, whereof we know nothng ſo much as that they are to us inviſible, and, probably, of a heterogeneous nature; it need be no great wonder, that the operation ſhould, alſo, be abſtruſe, and the effects uncommon. And there are clearer inducements to perſuade us, that another quality of the atmoſphere, its gravity, may be alter'd by unſeen effluvia aſcending from the ſubterraneous regions of our globe. We have often perceived, by the mercurial barometer, the weight of the air to be

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

NAT. HIST. more firmly arreſted, by a kind of precipitating faculty of the magnet, with regard to ſuch effluvia; nay, 'tis poſſible in ſome circumſtances of time and place, that one of our magnets may, as it were, fetch in ſuch ſteams, as wou'd indeed paſs near it, but wou'd not otherwiſe come to touch it. Thus I have made bodies, not all of them electrical, attract, without being excited by rubbing, &c. far leſs light bodies than the effluvia we are ſpeaking of.

SECT. II.

Celeſtial and aerial magnets.

SEVERAL bodies, which experience aſſures us imbibe or retain ſomething from the air, as calcined minerals, marcaſites, ſalts, factitious and natural, &c. may be often expos'd to it, and then weigh'd again, and farther diligently examined, whether that which makes the increaſe of weight be a mere imbibed moiſture, or ſomewhat elſe; and likewiſe, whether it be ſeparable from the body or not, or have endow'd it with any conſiderable quality. And experiments may be varied with a good magnet, by expoſing it long to the air, in regions differing much in climate, ſoil, or both; by expoſing it by day only, or by night, at ſeveral ſeaſons of the year, in ſeveral temperatures of the air, at ſeveral conſiderable aſpects of the ſtats and planets, by making it more or leſs frequently part with what it has gained from the air; and in ſhort, by having regard to that variety of circumſtances which human ſagacity will ſuggeſt. For by thus diverſifying the experiment many ways, we may, perhaps, by one or other of them, make ſome unexpected, and yet important diſcovery, of the effluvia wherewith the air in particular places, at particular times, abounds; and perhaps too of ſome correſpondence between the celeſtial and terreſtrial globes of the world.

Theſe, perhaps, will ſeem extravagant thoughts; but if I had been fortunate in preſerving all my obſervations, or other fruit, of ſome experiments I once made of this kind, it wou'd keep them from appearing ridiculous. To ſhew, however, that the air may not only have a notable operation upon vitriol, even after a ſtrong fire could work no farther on it; and that this operation was conſiderably diverſify'd by circumſtances; I ſhall make uſe of an obſervation of the experienced *Zwelfer*, who informs us; that "the colcothar of this mineral, made "by a ſtrong diſtillation, is not corroſive; and that no ſalt can be "obtained from it ſoon after diſtillation, by the affuſion of water; "but, ſays he, if it be for ſome time expos'd to the air, it will yield "a ſalt, which is ſometimes white, ſometimes of a beautiful purple "colour; and this I have obtain'd in large quantities, and ſometimes "alſo a nitrous kind."

This

This teſtimony has much the more weight with me, becauſe I find what he affirms of the ſaltleſſneſs of vitriol, newly and ſtrongly calcined, to be very agreeable to ſome of my experiments upon colcothar of blue vitriol; which is ſo odd a concrete, that I more than once recommended the making experiments upon it to ſeveral curious perſons; one of whom an induſtrious man, and vers'd in chymical operations, aſſured me, that not only he had different kinds of ſalts from colcothar expos'd to the air for many months, and robb'd at convenient times of what it acquired; but that in tract of time he found it ſo alter'd, that he obtain'd from it a conſiderable quantity of true running mercury. NAT. HIST.

Obſervations to be made on colcothar.

But there are two or three things that I wou'd deſire to be obſerv'd about this odd *Caput mortuum*. The firſt is, that ſome circumſtances be regarded, which moſt obſervers wou'd overlook; ſuch as the temperature of the air, the month of the year, the winds, the weight of the atmoſphere, the ſpots of the ſun, the moon's age, her place in the zodiac, and the principal aſpects of the planets, and other chief ſtats: for tho' it be a boldneſs to affirm, that any, or perhaps all theſe together, will be concern'd in the production of the ſalt, or other ſubſtance to be made or diſclos'd in the colcothar; yet in things new and exorbitant, it may be ſometimes raſh and peremptory, to deny even ſuch particulars as cannot without raſhneſs be poſitively aſſerted; and in our caſe, the ſmall trouble of taking notice of circumſtances, will be richly rewarded, by the leaſt diſcovery made in things ſo abſtruſe and conſiderable. And as we cannot yet pronounce ſo much as negatively, whether the libration of the moon, and the motion of the ſun, and perhaps of ſome of the other planets, about their own centers, and conſequently their turning ſeveral parts of their bodies to us, may have an operation upon our atmoſphere; ſo, for ought I know, there may be in thoſe vaſt internal parts of the earth, whoſe thin cruſt only has been here and there dug into, conſiderable maſſes of matter having periodical revolutions, accenſions, eſtuations, fermentations, or in ſhort, ſome other notable commotions; whoſe effluvia may produce effects yet unobſerv'd on the atmoſphere, and on ſome particular bodies expos'd to it; tho' theſe periods may, perhaps, be altogether irregular, or have ſome kind of regularity, different from what one wou'd expect. Thus the ſea has thoſe grand intumeſcencies, we call ſpring-tides, not every day, nor at any conſtant day of the month or week, but about the full and new moon; and theſe ſpring-tides are moſt notably heighten'd, not every month, but twice a year; at or about the vernal and autumnal equinoxes: which obſervations are not near ſo ancient, and ſo well known, as the daily ebbing and flowing of the ſea. The eteſians of the ancients I ſhall not now inſiſt on, nor the obſervations of the elder inhabitants of the *Caribbee* iſlands; who, when the *Europeans* firſt reſorted thither, had hurricanes but once in ſeven years; afterwards they were moleſted with them once in three years; and of late they are troubled with them almoſt every year. And a phyſician who lived there, told

NAT. HIST. me, he had ſcarce ever obſerv'd them to ſucceed one another in a leſs compaſs than of two months. In which inſtances, and ſeveral others that may be noted, of what changes happen to great quantities of matter, nature ſeems to affect ſomething of periodical; but not in a way that appears to us regular. We may add, what the learned *Varenius* relates of thoſe hot ſprings in *Germany*, he calls *Thermæ piperinæ*, of which he affirms this peculiarity, that they annually begin and ceaſe to flow at certain ſeaſons; the former about the 3d of *May*; and the latter near the middle of *September*; from which time they reſt till the following ſpring. And *Johannes de Laet* tells us, that "in the *Mexican* "province *Xilotepec*, there is a ſpring which runs for four years ſucceſſively, and remains dry for the four following; when it again "breaks out afreſh; and which, ſays he, is ſtrange, it affords leſs "water on rainy days, than it does in clear, dry weather."

And thus much may invite us to take notice of circumſtances in our obſervations on colcothar; which might with the greater hopes of ſucceſs be kept long expos'd, becauſe bars of windows, and other erect irons, have been found in tract of time to acquire a ſettled magnetiſm from the effluvia of the earth.

The other principal thing I wou'd recommend is, that notice be taken not only of the kind of vitriol, whereof the colcothar is made, as whether it be blue *Dantzick* vitriol, vitriol of iron, *Hungarian*, *Roman*, &c. but alſo to what degree the calcination is made, and how far the calcin'd matter is freed from the ſalt by water. For theſe circumſtances, at leaſt in ſome places, will be of moment, and may perhaps afford hints of the conſtitution of the atmoſphere in particular parts, as well as of the beſt preparation of colcothar for detaining the foreign effluvia. And I wou'd the rather have experiments try'd again in other places with colcothar not calcin'd to the utmoſt, nor yet ſo exquiſitely edulcorated, but that ſome ſaline particles ſhou'd be left in it for future increaſe; becauſe I have more than once purpoſely try'd, in vain, that the *Caput mortuum* of blue vitriol, whereof the oil and other parts had been driven off with a violent and laſting fire, wou'd not, when freſh, impart any ſaltneſs to water; nor do I think, that out of ſome ounces purpoſely edulcorated, I obtained one grain of ſalt: and this inſipid colcothar being expos'd, ſome by me, and ſome by a friend who had conveniency in another place not far off, to the air, ſome for many weeks, and ſome for ſeveral months; we did not find it to have manifeſtly increas'd in weight, or to have acquired any ſenſible ſaltneſs; which, ſuppoſing the vitriol to have nothing extraordinary, gave me the ſtronger ſuſpicion of ſome peculiarity in the air of that part of *London*, where the trials had been made; at leaſt, during thoſe times wherein we made them; becauſe not only former experiments made here in *England* had aſſured me, that ſome colcothars will gain a conſiderable addition of weight, by being expos'd to the air; but accidentally complaining of my diſappointment to a traveller, who had in many countries

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NAT. HIST.

does ſlowly, and not like *Aqua fortis*. When the liquor had, by this operation, acquir'd a thick, muddy colour, we decanted it into a clean wide-mouthed glaſs, which being left for a competent time in the open air, the expoſed liquor became of a fair green; tho' it did not appear that any thing was precipitated at the bottom to make it clear.

With how little confidence of ſucceſs, trials that have the aims of theſe are to be attempted, conſideration and experience have made me ſenſible; yet I would not diſcourage mens curioſity from venturing even upon ſlight probabilities, where the deſign and the nobleneſs of the ſubject may make even ſmall attainments very deſirable. And till trials have been made, on occaſions of great moment, 'tis not eaſie to be ſatisfied, that men have not been wanting to themſelves. What experiments I have made, relating to this ſubject, I ſhall here ſet down.

Experiments to manifeſt ſome latent qualities in the air.

1. Having occaſion to dulcify ſome calx of *Dantzick* vitriol, from which the oil had been long before diſtilled; water, was put upon two large portions of it, that the liquor might be impregnated with the vitriolic particles remaining in the calx; the water, put upon one of theſe portions was, ſoon after, being ſufficiently impregnated, filtred, and gently abſtracted; by which means it afforded a kind of ſalt of vitriol, that ſeem'd to differ very little from the vitriol which had been calcined. But the water, put upon the other portion of calcin'd vitriol, was, in a wide-mouth'd veſſel, left in the air for a month or ſix weeks; after which time, when it came to be abſtracted, it afforded many drams of a ſalt, that did not then, nor long after, look at all like common vitriol, or like the other; but ſhot white, almoſt like ſalt-petre, or ſome other untinged ſalt. Whether this experiment will conſtantly ſucceed, and at other ſeaſons of the year than in the ſummer, wherein 'twas made, I had not the opportunity to try fully. But that the air may have a great ſhare, in varying the ſalts, obtainable from calcined vitriol, ſeems the more probable, becauſe we had a parcel of colcothar that had lain for ſome years in the air, ſhelter'd from the rain; and cauſing a lixivium to be made of it, we found, when the ſuperfluous moiſture was exhaled, that its ſaline particles began to ſhoot into ſalt far more white than vitriol, and very different from it in its figure and way of concretion.

2. Exactly weighing an ounce of the colcothar of vitriol of copper, carefully dulcified, and left in my ſtudy at *Oxford*, during the months of *January* and *February*, and expoſing it to the air for ſome weeks, we found it to have thereby gained four grains, and about a quarter, beſides ſome little duſt that ſtuck to the glaſs. This experiment, compared with the following, will ſhew, that the difference of airs, ſeaſons, calces of vitriol, or other circumſtances, may produce a notable diſparity in the increaſe of the weight gain'd by the bodies expoſed to the air.

3. We

3. We put eight ounces of foreign vitriol, calcined to a deep red- NAT. HIST.
neſs, into a broad flat metalline veſſel, and ſet it upon a ſhelf, in a ſtudy that was ſeldom frequented; and at the ſame time, to obſerve what increaſe would be made by expoſing to the air a larger ſuperficies of the powder, with regard to its bulk, we put into another metalline veſſel, ſmaller than the other, only two ounces of colcothar, and ſet it on the ſame ſhelf with the other. This was done on *March* 12; and on *June* 25 we weigh'd theſe powders again, and found the eight ounces to have gained one dram and ſeventeen grains; and the two ounces had acquired the ſame weight within a grain; then putting them back into their former veſſels, we left them in the ſame place, as before, till *Auguſt* 24; when we found cauſe to ſuppoſe, that the greater parcel of colcothar had met with ſome miſchance, either by mice or otherwiſe; but the leſs weighed twenty ſix grains heavier than it did in *June*, amounting now to two ounces one dram forty two grains; having increaſed in leſs than ſix months above a hundred grains, and conſequently, above a tenth part of its firſt weight. No trial was made to diſcover what this acquired ſubſtance might be, leſt we ſhould thereby diſturb the intended proſecution of the experiment.

4. Becauſe in moſt of theſe experiments of ſubſtances expoſed to be impregnated by the air, or to detain its ſaline or other heterogeneous particles, we employed bodies prepared and much altered by the operation of the fire, we thought fit to make ſome trials with ſuch as were unchang'd by the fire; and to this purpoſe, we took ſeveral ſmall lumps of a marcaſite, which was partly of a ſhining, and partly of a darkiſh colour, and which ſeemed well diſpoſed to afford vitriol, amounting to two ounces; theſe were kept in a room where they were freely acceſſible to the air, which was eſteemed to be very pure. After the marcaſites had been kept in this room, ſomewhat leſs than ſeven weeks, we weighed them again, in the ſame balance, and found the two ounces increas'd by above twelve grains.

5. I once or twice obſerv'd the fumes of a ſharp liquor to work more ſuddenly or manifeſtly on a certain metal, ſuſtain'd in the air, than did the menſtruum it ſelf that emitted thoſe fumes on thoſe parts of the metal it covered. And a chymiſt, who had been in *Hungary*, and other parts, purpoſely to viſit mines, aſſured me, that as to the ladders and other wooden work, employed in one or more of the deep *Hungarian* mines, thoſe that were in the upper part of the grooves, near the external air, would, by the fretting exhalations, be render'd unſerviceable, in a few months; whilſt ſuch ladders, pieces of timber, *&c.* which were employed in the lower part of the mine, would hold good for two or three times as long.

6. A certain ſoft but conſiſtent body, about the bigneſs of a nutmeg, chymically prepared, and which, in the free air, would contiually emit a thick ſmoke, being put into a vial, and placed in a middle ſiz'd receiver on our pneumatic engine, continued ſome time to afford

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afford manifeſt fumes, whilſt the air was exhauſting, till at length the viſible aſcent of fumes, out of the vial, quite ceaſed; and the matter having remained for ſome time in this ſtate, the ſmoking ſubſtance was ſo altered as to emit no fumes, not only when the air was let into the receiver, but for a conſiderable time after the vial was taken thence, till it had been removed to the window; where the wind blowing in freſh air, it began to ſmoke as formerly. And this ſubſtance having been kept in a large glaſs, into which it was diſtill'd, at leaſt for five or ſix weeks, would ſmoke very plentifully upon the contact of the air, yet be kept from ſmoking, tho' the chymical receiver were ſtopp'd but with a piece of paper. Nay, farther, when a vial, containing ſome of it, was put, unſtopp'd, in the receiver of our air-pump, cloſe luted on, tho' no exhalation were made, yet the white fumes immediately ceas'd to aſcend, as if the ſmoke participated of the nature of flame, and preſently glutted the air, or otherwiſe made it unfit, without diminiſhing its gravity, to raiſe the body.

The growth of metals expoſed to the air in their ore.

Let us next conſider the generation of metals. But I deſign not to examine, whether metals and minerals, as if they were a kind of ſubterraneal plants, properly grow like vegetables; I here take the growth of metals in a looſe popular ſenſe, wherein a metal may be ſaid to grow, if an aſſigned portion of matter, which yet either diſcovers no metal, or but ſuch a quantity, as, being expoſed to the air, will, after a time, afford ſome, or a greater portion than it had before.

The growth of tin.

An ancient owner of mines aſſured me, he could, otherwiſe than upon vulgar conjecture, prove, that minerals grow even after the veins have been dug; and being deſired to let me know his proofs, he gave me theſe that follow: firſt, he ſaid, that not far from his houſe there was a tin-mine, which the old diggers affirmed to have been left off, ſome ſaid eighty, ſome a hundred and twenty years ago; becauſe they had, by their waſhing and vanning, ſeparated all the ore from the reſt of the earth; yet, of late years, they found it ſo richly impregnated with metalline particles, that it was wrought over again with a very great profit, and preferr'd to ſome other mines that were firſt wrought without having been ever ſo robb'd. And when I objected, that, probably, this might proceed from the lazineſs and unſkilfulneſs of the workmen in thoſe times, who left in the earth, the tin that was, or might be ſeparated; he anſwered, 'twas a known thing in the country, that in thoſe times the miners were more careful and laborious to ſeparate the metalline part from the reſt of the ore than now. He alſo affirmed, that in his own time, ſome tenants and neighbours of his, having got all the ore they could from a great quantity of ſtuff dug out of a tin-mine, they laid the remains in large heaps, expoſed to the air, and, within twenty five years after, found them ſo richly impregnated, that they wrought them over again,

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

NAT. HIST. earth; and this water is expanded, by being turned into ice; and this expanſion is made with an exceeding great force, by which it often ſtretches, or breaks through the things that contain it; whence 'tis probable, that ſometimes the narrowneſs of the ſubterraneal paſſages in mines, may proceed from the water imbibed by the ſurrounding ſoil, and being frozen in ſharp winters: for by this means the ſoil muſt forcibly endeavour to expand it ſelf, and actually do ſo in the parts contiguous to the paſſage, ſince there it finds no reſiſtance; and tho' the expanſion made in one year or two be but ſmall, and therefore not obſerv'd, yet in a ſucceſſion of many winters, it may, by degrees, grow to be very conſiderable. But Dr. *Brown*, in his travels, ſpeaking of a mine, has theſe words: "Some paſſages in this mine cut thro' the "rock, and long diſuſed, have grown up again; and I obſerv'd the "ſides of ſome which had been formerly wide enough to carry their "ore thorough, to approach each other; ſo that we paſs'd with diffi-"culty. This happens chiefly in moiſt places; and the paſſages unite "not from the top to the bottom, but from the ſides." Upon the whole; I take the argument drawn from the increaſing ſtraitneſs of the paſſages in mines, to make more for the growth of metals, than what is much relied on by ſome writers, who urge, that in churches, and other magnificent buildings that are leaded over, the metalline roofs, in a long tract of years, greatly increaſe in weight; ſo that often there is a neceſſity to remove them. For having had ſome occaſion to obſerve and enquire after this kind of lead, I ſoon ſuſpected, that the increaſe of weight, which ſometimes, indeed, may be very great, was no clear proof of the real growth of the metal it ſelf. In that which I had occaſion to conſider, the additional weight, as well as bulk, ſeem'd to proceed from ſharp, or other ſaline corpuſcles of the timber of the buildings; which by degrees exhaling and corroding the ſide of the lead whereon they faſtened, turned it with themſelves into a kind of ceruſe. For, 1. I have found by trial purpoſely made, that woods afford an acid, tho' not a merely acid liquor, capable of corroding lead. 2. 'Tis known, that lead turned into ceruſe, gains conſiderably in weight; ſome ſay ſix or ſeven pound in the hundred. 3. From the ſheets of lead that have very long cover'd churches, and the like buildings, there is often obtained, by ſcraping, a large proportion of white lead, which I have known much preferr'd by an eminent artiſt, to common ceruſe, when a white pigment was to be employ'd. And, by the way, men finding this ceruſe, not on that ſide of the lead which is expos'd to the external air, where I ſcarce ever obſerved any, but on the inſide that lies on the timber, and other wooden work, it may diſabuſe thoſe who fancy this ceruſe to be a part of the lead calcined by the beams of the ſun. And if to this be added, that by diſtillation, and otherwiſe, I have found cauſe to ſuſpect, that alabaſter and white marble may emit ſpirituous parts, which will invade lead; it may be doubted, whether what *Galen* relates of the great intumeſcence of the leaden bands, where-

wherewith the feet of ſtatues were faſten'd to their pedeſtals, be a ſure argument of the real growth of that metal in the air. NAT. HIST.

The growth of iron.

I cou'd not find in one of our chief iron-mines, that there was any notice taken of the growth of iron; but in another place or two, ſome who deal in iron-ore informed me, that they believe it grows, and may be regenerated; and upon that account one of them ſat up a work contiguous to ſome land of mine, to melt over again the remainder of ore that had been already wrought at a great diſtance from that place; and had for ſome ages lain in heaps expos'd to the free air. But of the growth of iron in the iſland of *Ilva* in the *Tyrrhene* ſea, near the coaſt of *Tuſcany*, not only ancient writers, as *Pliny* and *Strabo*, take particular notice; but modern mineraliſts of very good credit, as *Fallopius* and *Cæſalpinus*. The latter tells us, that "an incredible "quantity was there produc'd in his time; and that even the earth "which they throw up in digging the vein, after a while becomes a "vein it ſelf." *Agricola* gives us the like account of a place in *Germany*; and the learned *Joh. Gerhardus* aſſures us, he was told by one who dug in the iron-mines near *Amberg*, that "the mere earth there dug up with "the ore, being mix'd with the droſs of the iron, and thrown in heaps, "expos'd to the ſun, and the rain, uſually in 15 years time afforded, "by melting, a thin kind of iron fit only for plates."

The growth of ſilver.

In a *French* collection of voyages, publiſhed by a perſon of great curioſity and induſtry, there is an account given by a gentleman, of a late voyage he made to *Peru*. This gentleman informs us, that the beſt ſilver in all the *Indies*, and the pureſt, is that of the mines of *Potoſi*; where they draw this metal even from the mineral earths; which were formerly thrown aſide, when the ground was opened, and the grooves and ſhafts in the mountains made; metal having been obſerv'd to be form'd in them afreſh ſince thoſe times; which ſufficiently ſhews the propenſity of the ſoil to the production of this metal: yet 'tis true, adds he, that theſe impregnated earths yield not ſo much as the ordinary oré found in veins betwixt the rocks.

The growth of gold.

As for the growth of gold, the inquiries I have yet made, among travellers, give me no great ſatisfaction about it; and tho' I have diſcours'd with ſeveral who had been at *Guinea*, *Congo*, and other parts of *Afric*, where much gold is to he had; yet I cou'd not learn, that they, or any acquaintance of theirs among the natives, had ſeen any mines or veins of gold. And afterwards meeting with a learned traveller, who had carefully viſited the famous gold-mine at *Cremnitz* in *Hungary*, he aſſured me, he cou'd not learn from the miners, whether or no the ore of gold, *&c.* did really grow, or were regenerated in tract of time, by being expos'd to the air, or upon any other account. But the grand overſeer, who was lord of part of the ſoil, told him, that he thought the whole mountain abounded with particles of gold; and therefore when the diggers had almoſt exhauſted a vein, he there caſt in large

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quantities of earth, and fell to work upon other neighbouring places; whilſt that earth being kept there, as in a reſervatory, wou'd afterwards afford gold as the mine had done before. And a late *German* profeſſor of phyſic ſays, that " at *Corbac*, a city of *Weſtphalia*, they " melt gold out of their heaps of earth once in four years; in which " time they find it generated afreſh." " The common yellow earth " of the country near *Cremnitz*, ſays Dr. *Brown*, in his travels, eſpe- " cially of the hills towards the weſt, altho' not eſteemed ore, affords " ſome gold. And in one place, I ſaw a great part of a hill dug away, " which had been caſt into the works, waſh'd and wrought in the ſame " manner, as pounded ore, with conſiderable profit." I have alſo ſome fine gold that never endured the fire, taken out of tin-ore. But whether it be the contact or operation of the air, or ſome internal diſpoſition, analogous to a metalline ſeed or ferment, that cauſes this increaſe in metals, I dare not be poſitive; tho' the probable intereſt of the air herein, will ſufficiently excuſe my alledging theſe inſtances, as favourable to my ſuſpicion, till further experience ſhall have more clearly inſtructed us.

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ral ſubſtances, uſually incorporated with them; whilſt the great variety and efficacy of thoſe virtues may be owing to ſome happy concurrent circumſtances of that commixture. The former of theſe heads relates properly to the origin of gems; and the latter, partly to that, and partly to the kinds and degrees of their virtues.

But that any gems, eſpecially the hardeſt ſort, ſhould have a later beginning than the earth it ſelf, will, probably, appear a paradox; and I doubt not it will paſs with many for a great one, that ſome of theſe hardeſt of ſolid bodies, ſhould have once been fluids; but the following conſiderations will countenance this hypotheſis.

That gems were once fluid, argued from their tranſparency.

And firſt, the tranſparency of diamonds, rubies, ſapphires, &c. agrees very well with this conjecture, and thereby ſeems to favour it; for 'tis not ſo likely, that bodies which were never fluid, ſhould have their conſtituent parts ſet in the order requiſite to tranſparency as thoſe that were once in a liquid form; during which it is eaſie for the rays of light to make themſelves paſſages every way, and diſpoſe the ſolid corpuſcles after the manner neceſſary to the conſtitution of a tranſparent body. Thus we ſee, that ſilver diſſolved in *Aqua fortis*, or lead in ſpirit of vinegar, having thereby had their particles reduced to a fluid ſtate, thoſe particles, tho' before opake, are ſo diſpoſed as to make not only a diaphanous ſolution, but, if deſired, tranſparent cryſtals; and the experiments that chymiſts uſually make with theſe metals, I have made with ſeveral ſtones. But this argument is produced rather to confirm, than prove my conjecture.

Figuration.

2dly, The origin I aſſign to gems, may be alſo countenanced by the external figuration of ſeveral of them. For we plainly ſee, that the corpuſcles of nitre, alum, vitriol, and even common ſalt, being ſuffered to coagulate in the liquors wherein they floated before, will convene into cryſtals of curious and determinate ſhapes. And the like I have tried in ſeveral metalline bodies, diſſolved in their reſpective menſtrua. But unleſs a concreting ſtone, or other like body, be either ſurrounded with, or in great part contiguous to a fluid, 'tis not eaſie to conceive how it ſhould acquire a curious, angular, and determinate figure. For concreſcent bodies, if they have not room enough in an ambient fluid for the moſt ſuitable ranging of their parts, cannot caſt themſelves into ſuch fine and regular ſhapes as ſeveral gems ſeem to affect; but the matter they conſiſt of, muſt conform to the figures of the cavity that contains it, which, in this caſe, has not ſo much the nature of a womb, as of a mould. Thus we ſee ſalt-petre, and ſeveral other ſalts, if the water they were diſſolved in be too far exhaled, before they are ſuffered to ſhoot, will, if the liquor fill the glaſs, ſometimes coagulate into a maſs, faſhion'd like the inſide of the containing veſſel; or if a conſiderable quantity of liquor remain after the coagulation, that part of the nitre which was reduced to concrete next the glaſs, will have the ſhape of the internal ſurface thereof; but the cryſtals contiguous to the remaining liquor, having

a fluid

a fluid ambient to ſhoot in, will have the part of their bodies contiguous to the liquor, curiouſly form'd into ſuch priſmatical ſhapes as are peculiar to nitre. NAT. HIST.

To apply this to gems. That many kinds of them have geometrical and determinate ſhapes, I have often obſerved, in viewing them as nature produced them; for I have had the good fortune to take ſeveral out of their wombs. And upon freeing a large number of *Indian* granats from a lump of heterogeneous matter, whoſe diſtinct cavities, like ſo many cells, contained ſtones; on ſome of their ſurfaces appeared triangles, parallelograms, *&c.* And from the rock, whence thoſe ſtones chiefly come, that are commonly called *Briſtol* ſtones, I procured a number of them to be dug up in my preſence; many of which appeared to be curiouſly and determinately figured, much like ſome cryſtals of nitre that I have taken pleaſure to compare with them. And the like configuration I have, alſo, obſerved in many *Corniſh* diamonds; and particularly in a fair large one found growing, with many leſſer, in *Ireland*. Nor is it only in theſe ſofter gems, that this curious figuration may be met with; for I found, among many ſtones which I took to be rubies, and which are exceeding hard, a conſiderable number, whoſe figure, tho' not the ſame with the *Corniſh* and *Iriſh* ſtones, were yet fine and geometrical. And the like I have obſerved even in diamonds themſelves; and particularly in a large one that was rough, I perceived the ſurface to conſiſt of ſeveral triangular planes, not exactly flat, but including, as it were, ſmaller triangles within them; that for the moſt part meet at a point, and ſeem to conſtitute a very obtuſe, ſolid angle. Encourag'd by this, I examined ſeveral other rough diamonds, and found moſt of them to have angular and determinate ſhapes, not unlike thoſe already mentioned. And having thereupon conſulted an expert jeweller, he told me, he generally found them to be ſhaped like that I ſhewed him; and added, that ſuch a ſhape was the mark by which he uſually judg'd a ſtone to be a right diamond, if he had not an opportunity to examine it by the hardneſs.

And, in favour of the compariſon betwixt the coagulation of ſalt-petre and that of gems; having once made an odd menſtruum, wherein I was able to diſſolve precious ſtones, there ſhot in the liquor pretty large cryſtals, ſo tranſparent and well ſhap'd, that they might eaſily have paſs'd for thoſe of nitre, but were, nevertheleſs, inſipid. And I have often taken notice in ſuch ſtones as the *Briſtol* diamonds, that tho' the part, which may be look'd upon as the upper, were curiouſly figured with ſix ſmooth ſides, which, at the top, ſhaped off ſo as to make ſix triangles, that terminated like thoſe of a pyramid in a point; yet that which may be look'd upon as the root, or the lower part of the ſtone, was much leſs tranſparent, and of an irregular figure: the reaſon of which ſeems to be, that this being the part whereby the ſtone adhered to its womb, was ſullied by the mud-

Nat. Hist. muddineſs thereof, and reduced to conform it ſelf to the ſhape of the contiguous cavity; whilſt the upper part of the ſtone was not only form'd of the clearer portion of the petreſcent juice, before the wateriſh vehicle was exhaled, but had room and opportunity to ſhoot into the curious figure belonging to its nature. And this is much more conſpicuous, where many of theſe cryſtals grow in cluſters out of one mineral cake or lump. Thus I have ſeen it in thoſe ſoft tranſparent concretions which ſome of the late mineraliſts call *Fluores*; and particularly in a very fine mineral lump ſhew'd me by a great prince. For this maſs conſiſted of two flat parallel cakes, that ſeemed compoſed of a dirty kind of cryſtalline ſubſtance, and out of each cake there grew, towards the other, a great number of ſtones, ſome of which, by their coheſion, kept the two cakes together; and moſt of theſe ſtones, having each of them a little void ſpace about it, wherein it had room to ſhoot regularly, were geometrically ſhap'd and colour'd like a *German* amethyſt. And I have my ſelf a pretty large ſtone, taken up here in *England*, which conſiſts of four parts; the lowermoſt whereof is a thin broad flake of coatſe ſtone, only adorned here and there with very minute glittering particles, as if they were of a metalline nature; over this is ſpread another thin white opake bed, which is ſo inclos'd between the former part and the two others, that, without defacing the ſtone, I cannot well examine it. The third conſiſts of a heap of minute cryſtals, exceedingly thick ſet, which therefore look whitiſh; having little or no tincture of their own; and this part, like the former, is not much thicker than a barly corn. The fourth and uppermoſt part, which ſeems, in great meaſure, to be the ſame cryſtals, that, as they grow higher and ſpread, acquire a deeper colour, is made up of a large number of amethyſts, ſome paler, and others highly tinged; which are of very different figures and magnitudes, according as they ſeem to have had conveniency to ſhoot; theſe, at one end of the ſtone, lie in a flat bed, ſcarce exceeding a barly-corn in length, whilſt thoſe, at the other end, ſhoot up to a conſiderable height into figur'd cryſtals, ſome of them as big as the end of my little finger, which were the moſt deeply colour'd, being alſo of a great hardneſs; for I found they would eaſily cut glaſs.

I remember, alſo, that from a famous quarry which ſtood near a ſpring, that had a petreſcent faculty, I caus'd ſeveral ſolid pieces of rough opake ſtone to be broken, in hopes of finding ſome finer juice therein coagulated into ſome finer ſubſtances; and accordingly I obſerved, that in ſeveral places the ſolid maſſy ſtone had cavities in it, all about the ſides whereof there grew concretions, which, by their limpidity and curious ſhape, ſeem'd to have been ſome finer petreſcent fluid, that by a kind of percolation thro' the ſubſtance of the groſſer ſtone, had at length, arriv'd at thoſe cavities; and upon the evaporation of the ſuperfluous, aqueous parts, or by their being ſoak'd

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fluid ſubſtances, I manifeſtly perceived, with my naked eye, ſeveral parallel commiſſures therein; which ſeemed plainly to be made by the contiguous edges of little thin plates of ſtone, that appear'd to lie one over another, almoſt like the leaves of a book a little opened.

I remember alſo, that by holding a large, rough, grizolette, that is, a hard gem of a bluiſh colour, brought from *Eaſt-India*, againſt the light, and curiouſly obſerving it, I have ſometimes plainly diſcovered a grain, as they call it, therein; according to the tendency whereof, I have been aſſured by a ſkilful artiſt, who uſed to make ſeals of theſe ſtones, that they wou'd uſually ſplit. I forbear to urge, that in ſome other precious ſtones cut and poliſhed, as particularly the hyacinth and ſapphire, by turning them ſeveral ways to the light, I have obſerv'd commiſſures ſo fine, as not to prejudice the entireneſs of the ſtone for the lapidaries purpoſe; becauſe the phenomenon is far leſs conſiderable than what I have often obſerved in *New-Engliſh* granats; wherein, eſpecially when they are broken, the edges and commiſſures of the thin plates, or flakes, whereof they conſiſted, are very eaſily diſcernable. And to try whether this obſervation wou'd hold even in the hardeſt ſtones, I had recourſe to a pretty large, unwrought diamond; which being placed in a microſcope, ſhew'd me the commiſſures of the flakes I looked for, whoſe edges were not ſo exactly diſpos'd into a plain, but that ſome of them ſtood very ſenſibly extant, like little ridges, broad at the top, above the level of the reſt. And theſe parallel flakes, with their commiſſures, I cou'd in a large diamond plainly diſcern, even with my naked eye. And further, an eminent jeweller, and another artificer, whoſe trade it was to poliſh and cut diamonds, aſſured me, upon their repeated and conſtant experience, that 'twas almoſt impoſſibe to ſplit diamonds ſmoothly, in a direction contrary to their grain; but eaſily, and at one ſingle ſtroke, with a ſteel tool, when once they had found in what line their inſtrument ſhould be impell'd. By this 'tis evident, that diamonds themſelves have a grain, or flaky con extu re, not unlike that of wood, which will readily be granted to conſiſt of aſſimilated water or juices, that having been once fluid, were fit to have their particles ſo rang'd or diſpos'd, as to conſtitute a body far more eaſy to be cleft along the direction of its fibres, than in a way contrary thereto. And I remember, that having obſerved in a rough diamond, which I purpoſely examined, the flakes whoſe edges were terminated in one of its plains, to be far from running parallel to thoſe whoſe edges compos'd another; I imagined, that if this diamond were to be cleft, it wou'd not be ſmoothly ſplit into two pieces, becauſe the commiſſures probably made angles in the body of the ſtone; and accordingly, I learn'd of a diamond-cutter, that he ſometimes met with ſtones, which baffled all his ſkill, and wou'd by no means ſplit, like others, into two parts; but before they were cleft quite thorough, break in pieces. And this diſpoſition in the ſtone he cou'd not certainly foreſee.

4*thly*,

4*thly*, It ſeems not improbable, that the colours of ſome gems are adventitious, and were imparted to them either by ſome tinging mineral juice or exhalation, whilſt the ſtone was either *in ſolutis principiis*, or of an open texture. And this argument is too conſiderable to be ſlightly paſs'd over. For in the firſt place, a multitude of gems have been deprived of their colour, by continuing long in the fire; and the experienced *Boetius de Boot* affirms, that all gems will loſe their colour by this means, except *Bohemian* granats. How far this may hold true, I have not had opportunity thoroughly to examine; but I well remember, that having purpoſely expos'd ſeveral gems in a crucible, to a moderate fire, ſome of them ſeemed to have their tincture much impair'd, and others quite deſtroyed thereby. But if theſe trials be not warily made, they may eaſily impoſe upon us; eſpecially if we do not conſider the nature and cauſe of whiteneſs: for any diaphanous body, as far as I have yet obſerved, being divided into a multitude of very minute parts, and conſequently acquiring a multitude of diſtinct ſurfaces, which briſkly reflect the light every way outwards, will appear to have a white colour, more or leſs vivid, as the particles are more or leſs numerous, minute, and otherwiſe fitted to ſcatter the incident rays. Thus fine *Venice* glaſs reduced to powder, will be white; and even red ink, if ſo ſhaken, as to be brought to a froth, conſiſting of many minute bubbles, will ſeem whitiſh: whence, if by too haſty an ignition or refrigeration of the gems, they come to be flaw'd with innumerable little cracks, they may be thought to become white by having their tincture driven away; when their whiteneſs really proceeds from the multitude of thoſe little flaws, which are ſingly unperceived; and this the rather, becauſe the body may ſtill retain its former ſhape, or ſeeming entireneſs. To illuſtrate this, I have ſometimes heated a piece of cryſtal red hot in a crucible, and then quenched it in cold water; for even when the parts did not fall aſunder, but the body retained its former ſhape, the multitude of little cracks that were by this operation produced in it, made it quite loſe its tranſparency, and appear a white body. In making this experiment, the multitude of the flaws produced may be rendered more viſible, if the heated cryſtal be warily and dexterouſly quenched in a very deep ſolution of cochineal, made with ſpirit of wine; whereby, if the operation be well perform'd, enow of the red particles of the ſolution will get into the cracks of the cryſtal, to give it a pleaſing colour.

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Their colours being probably adventitious.

(2.) The colours of ſeveral gems, when not deſtroyed by fire, will be altered thereby; which happening to ſeveral foſſil pigments, and other bodies, confeſſedly mineral, argues a mixture of mineral ſubſtances in the ſtones, whoſe colours receive thoſe alterations; for there may be a change of colour produced by the fire, without any alteration of the tinging parts conſidered in that capacity. Thus by flaming the heated gem, in very many parts, a degree of whiteneſs or paleneſs emerging thereupon, may ſomewhat change its former co-

NAT. HIST. lour: but this alteration being only a kind of dilution, is not that which I here mean. I have, by expoſing *Indian* granats, in a crucible, to the fire, found them exchange their reddiſh colour for a dark and dirty one, like that of iron long kept in the air. And having kept ſome pieces of agate prettily adorned with waves of different colours, for a competent time in the fire, I found, that the greateſt part of the agate ſeem'd to be depriv'd of its tincture, and reduc'd to a pleaſant whiteneſs. But in ſome places, where there were ſtains of a different kind from the reſt, and where there run little veins that I ſuſpected to be of a metalline nature; the colour was not deſtroyed, but changed; and the veins of the pigment acquir'd a deep redneſs, which they will retain, if let alone; tho' I was induced, by ſome trials I made on other pieces of *Indian* agate, to think, that even theſe metalline tinctures might be driven away by a more laſting fire, ſo as to leave the ſtones purely white. A like change of colour is, likewiſe, found in ſome other ſtones; as alſo in ſome pebbles, amongſt ſeveral of which, that loſt only their tranſparency by ignition and extinction in water, one or two acquired a colour remarkably deeper than they had before.

(3.) Having borrowed an *Oculus mundi*, its colour white, figure round and plano-convex, and diameter about a third part of an inch; I put it into a very ſhallow glaſs-veſſel, almoſt fill'd with fair water, and obſerv'd within a minute, that one part of the edge began to appear ſomewhat tranſparent; and the whole ſtone, by degrees, loſt its whiteneſs, appearing of a dark browniſh colour. This change had reach'd the whole ſurface, by lying nine minutes in the water; then taking it out, I perceiv'd the body was grown half tranſparent, and the parts, near the edge, being leſs thick, appeared to have loſt much more of their former opacity than the innermoſt part. Then putting the ſtone preſently into the water again, I let it lie there till half an hour was expired from the beginning of the experiment; when, taking it out, and wiping it, I found it was grown much clearer; for being held againſt the light, it looked almoſt like yellow amber, but not quite ſo tranſparent. I next expoſed it to the air, in a very good balance (where it weigh'd four grains and about a quarter) and there left it for near half an hour, to try, if by the receſs of any imbib'd aqueous moiſture, it would become lighter; but I was hindered from compleating the experiment. Tho' this did not deter me from making another obſervation, which was, that within about a minute after, I found a portion of the ſtone, near one part of the edge, grown manifeſtly opake and whitiſh; and in a few minutes more the whole ſtone began to appear in a changing condition, but did not change in every part at once, nor did the alteration make an uniform progreſs; but one might ſucceſſively diſcover ſeveral white arches, or as 'twere zones, parallel to each other; and theſe being quite opake, intercepted between them other little zones, which being yet ſemi-opake, ap-

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NAT. HIST. cibly ſeparated therefrom. But tho' I tried this upon ſome parcels of granats, yet I found there were not many in the heap that would eaſily adhere to the magnet.

(7.) Some gems, which jewellers without ſcruple, affirm to be rubies, ſapphires, *&c.* are either colourleſs, or have other colours than thoſe which uſually belong to them. The famous goldſmith *Benvenuto Cellini* ſays, there is one kind of rubies naturally white, which he proves by the degree of hardneſs peculiar to rubies. And the ſame author mentions white berils, topazes, and amethyſts; and, by his account, the *Italian* jewellers think not the tinctures of gems any thing near ſo eſſential to them as we commonly repute; ſince they reckon topazes and ſapphires, whereof one is blue, and the other yellow, but both extremely hard in compariſon of all other gems, except diamonds, to be of the ſame ſpecies. The degree of hardneſs in rubies and ſapphires is often ſo equal, that I knew an expert *Engliſh* jeweller, who for that only reaſon took them to be the ſame kind of ſtone.

And that gems, referr'd by lapidaries to the ſame kind, may be very differently tinged, is a truth whereof I have ſeen notable inſtances in diamonds themſelves; which I therefore prefer to other examples, becauſe the extreme hardneſs of diamonds is what keeps jewellers from miſtaking any other ſtone for them; if they may be allow'd to try them on the wheel employed to cut them. Now of true diamonds I have ſeen ſome that were yellowiſh, others more yellow, and among the reſt, one that was ſo perfectly yellow, that I at firſt took it for a fair topaz, tho' it was valued at near three pound weight of gold. I have alſo ſeen rough diamonds, as they came directly out of the *Indies*, which were either bluiſh or greeniſh, and one particularly which was ſo green, that if its ſhape, *&c.* had not convinc'd me of the contrary, I ſhould have taken it for an emerald.

I once purchaſed a conſiderable number of ſmall rubies, many of which were curiouſly ſhap'd; and coming to look upon the whole parcel more leiſurely, I found one colourleſs, but in other reſpects ſo like the reſt, that I conjectured it of the ſame kind, only coagulated and hardened before the mineral pigment had tinged it of the colour of the reſt. And I was confirm'd in my gueſs by a gentleman, who had been in the chief places of the *Eaſt-Indies*, where rubies are found, and particularly at the river of *Siam* or *Pegu*, where he frequently ſaw theſe ſtones taken from the bottom of the water, and, ſometimes, took them out himſelf. This gentleman aſſured me, he had there ſeen ſeveral ſtones, each of which was partly a ruby and partly colourleſs; and that, ſometimes, in the ſame ſtone there would be two portions of one ſort, and a third, lying betwixt them, of another; which has frequently oblig'd the jewellers conſiderably to leſſen the bulk of ſuch ſtones, by cutting off the untinged part. And if my memory does not much deceive me, I ſaw, in a curious prince's cabinet, a ring ſet with a ſtone of a moderate bigneſs, whereof only about one half was

well

well tinged, while the other remained colourleſs. In gems that are leſs precious, and not ſo tranſparent, eſpecially in agate and opake ſtones, I could eaſily give a multitude of inſtances of the ſame entire ſtone being differently tinged in ſeveral parts; and I uſually wear, in a ring, a ſmall ſardonyx, wherein there are three portions, one within another; the uppermoſt whereof is black, the middle a kind of cheſnut colour, the other blue, almoſt like a tarquoiſe; each of which portions is exactly of a fine oval figure, and each of the two outermoſt of a very uniform breadth and colour throughout, and exactly parallel to the other. And to inſtance in tranſparent ſtones, 'tis known, that jewellers reckon among ſapphires, not only that ſort of azure ſtones which uſually paſs under that name, but alſo another kind, becauſe of their ſapphirine hardneſs; tho' for their want of tincture they call them white ſapphires. NAT. HIST.

(8.) We ſometimes ſee gems partly tinged, and partly not, in ſuch a manner as if the pigment, mixing with one portion of the matter, whereof the ſtone conſiſted whilſt it was liquid or ſoft, were not able to diffuſe it ſelf thro' the whole, nor to give an equally intenſe colour to all the portions in tinges. 'Tis true, in ſome caſes the diffuſion may be ſtopped by the petreſcent juices firſt coagulating in a part where the tincture was not mixed; and perhaps in others, the different colours may have belong'd to different portions of matter coagulating upon or againſt each other, at different times, yet ſo as to ſeem one entire ſtone; but which ſoever of theſe explications be admitted, it will confirm our hypotheſis, that the origin of gems is from a fluid or ſoft material. I have in ſome hard ſemi-diaphanous ſtones, as well *European* as *Eaſt-Indian*, obſerved a very irregular and unequal diffuſion of tincture. And in *Italy*, I have ſeen a large piece of cryſtal, whereof the pyramidal part was of a tranſparent green, whilſt the vertex appeared richly tinged like an emerald; but the farther the colour ſpread from thence, the fainter and paler it grew; ſo that before it came near the baſe, it was quite ſpent, and left the larger part of the ſtone tranſparent and colourleſs, like ordinary cryſtal. And hence, perhaps, we may explain the meaning of *Joſephus Acoſta*, where he ſays, that emeralds grow in ſtones like cryſtal; that he had ſeen them in the ſame ſtone faſhion'd like a vein; and that they ſeem, gradually to thicken and refine. And this learned author has a memorable obſervation, that may confirm both what I have juſt now related, and what we mentioned a little above about colourleſs gems: "I have ſeen, ſays he, ſome that "were half white and half green; others all white, ſome green, and "very perfect."

To conclude, I have given to pieces of rock-cryſtal, tolerably good tinctures by mineral fumes; and ſuppoſing the pieces, thus coloured, to be entire ſtones, as they generally appeared to be, the inſtance will be pertinent to our purpoſe; for tho' the colours thus given, do not uſually penetrate very deep, and are aſſiſted by no faint degree of heat; yet,

NAT. HIST. yet, on the other ſide, theſe cryſtals had attained their full hardneſs, and, after their colouration, were cut and poliſh'd like others; whilſt the gems we mean, are ſuppoſed to have been tinged under ground, when they were yet fluid, or at leaſt ſoft. That there are ſometimes generated in the bowels of the earth, mineral exhalations, capable of applying themſelves to the ſtones they meet with there, is certain; and that alſo ſome hard and ſtony ſubſtances have been actually tinged by ſuch mineral ſteams, I ſhall hereafter ſhew. I remember too, even in ſo hard a gem as a ſapphire, to have obſerved the efficacy of theſe ſubterraneal fumes; for I have often ſeen one of thoſe ſtones, wherein a fine ſeal was cut, which continued ſo oddly tinged, notwithſtanding what had been taken off to reduce it to an exquiſite ſhape, that a ſkilful perſon of my acquaintance, by whom it had been engraven, aſſured me, that he found it of the full hardneſs of a ſapphire, and that the mineral fumes had ſo ſtained it, that, in his opinion, it might, by the look, paſs for a chalcedonian.

Heterogeneous matter having been found in their ſubſtance.

5thly, Solid gems may include heterogeneous matter in them. Several inſtances of this ſort I have ſeen in opake ſtones; but in tranſparent ones they are very great rarities; and therefore it will not, I preſume, be thought ſtrange, if I mention but a few. Firſt then, a very ingenious lady, who had accompanied her huſband in an embaſſy to a great monarch, aſſured me, that ſhe brought back with her a piece of cryſtal, in the middle whereof there was a drop of water, that by its motion might be very eaſily obſerved; eſpecially when the cryſtal was made to change its poſture; and I have in ſome pieces of rock-cryſtal obſerv'd particulars, which ſeemed to argue, that ſomewhat or other was intercepted in the body of the ſtone.

A curious perſon who traded in *Indian* gems, particularly in grizolets; averr'd to me, that among ſeveral rough ones brought from the *Indies*; he had ſeen one that was about the bigneſs of a filberd; in the ſolid ſubſtance whereof there was a cavity, with a certain liquor in it, which, by changing the poſture of the ſtone, might be made to move to and fro. And when the drop was ſettled, it was of the bigneſs of a round pearl, that he ſhewed me, which wanted ſomewhat of a moderate ſize for a necklace; he added, that this rarity cauſed the ſtone, which was otherwiſe of ſmall value, to be priz'd at an hundred pounds. And I have my ſelf ſeen a monſtrous gem, which was little leſs a rarity than the former. And what renders this account of the grizolet the more probable, having broken a ſtone, that was brought as a rarity from the *Eaſt-Indies*, where gems are often harbour'd in ſuch ſtones, I found in the ſolid ſubſtance of it, which was ſo hard as to ſtrike fire like a flint, and in its little flakes was at leaſt ſemi-diaphanous, a cavity, wherein were coagulated very minute, poliſhed, cryſtalline ſtones, that ſeemed to have their points inwards; which argued there had been ſome liquor there, wherein theſe glittering particles had ſhot, tho' in proceſs of time, the remaining and incoagulable part of it might have been imbibed

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And metalline, or mineral bodies mixed with their ſmalleſt particles.

ſecond part of our hypotheſis; for if it ſhall appear, that many tranſparent gems have metalline, or other extraneous mineral bodies, intimately mingled with their ſmalleſt particles, it will be very reaſonable to ſuppoſe, that ſuch a mixture was made, when the bodies were in a fluid form; how elſe ſhould the metalline corpuſcles be convey'd into ſuch compact and hard bodies as gems? But if our hypotheſis be admitted, 'tis eaſie to apprehend how among bodies ſo entirely different as metals and ſtones, ſuch exquiſite mixtures may be made, as are required to give an uniform colour, tranſparency, and figure to them.

To ſtrengthen the preceding circumſtances, I ſhall add the teſtimony of a late *French* author, who wrote about the method of eſtimating gems, according to the rates of modern jewellers. This curious gentleman gives us, from the mouth of the late famous travellers he converſed with in ſeveral parts, an account of the number and names of the places where diamonds and rubies are found in the *Indies*; adding ſome circumſtances and particularities about the quality of the ſoil in thoſe places, that I have not elſewhere met with. Speaking of the firſt of thoſe three diamond-mines, which he takes to be the only ones in the *Eaſt-Indies*, after having told us, that the ſtones are there found ſome in the ground, and ſome in the rock, he adds, that thoſe drawn from the rock, or the neighbouring parts, have commonly a good water; but for thoſe which are drawn out of the ground, their water partakes of the colour or ſoil wherein they are found; ſo that if the earth be clean, and ſomewhat ſandy, the diamonds will be of a good water; but if fat, black, *&c.* they will have ſome tincture thereof: nay, he immediately annexes, that if there be ſome black or red ſand among the earth, the diamond will alſo retain ſome grain of it. And mentioning the ſecond mine of diamonds, he declares, that here, as in the former, the ſtones partake of the quality of the ſoil; ſo that if that be boggy or moiſt, the ſtone will incline to blackneſs; and if reddiſh, 'twill have an eye of that colour. He alſo tells us, that of late there were found in the kingdom of *Golconda*, ſtore of diamonds; which being brought to the firſt miniſter of ſtate, he forbad all further ſearch after them, becauſe not one in the whole number had a good water; the whole parcel being either black or yellow.

Whether gems are faſhion'd by ſome ſeminal or plaſtic power?

Before we proceed further, 'tis proper in this place to take notice of a conſiderable objection that may be offer'd, againſt the doctrine hitherto deliver'd. This objection is taken from the configuration of ſome gems, and eſpecially the priſmatical one of cryſtal, whereof we have given ſeveral inſtances. For it ſeems ſcarce poſſible, that ſo curious a ſhape ſhou'd be ſo uniformly produced, in ſuch a multitude of cryſtals, great and ſmall, unleſs there were ſome ſeminal and plaſtic power to faſhion their matter in a regular and geometrical manner.

But he who ſhall attentively conſider the figuration of ſalts, and of metalline and other magiſteries diſſolved and coagulated with them, may be thereby greatly aſſiſted to diſcover the invalidity of this ob-

objection; but becauſe 'tis very ſpecious and important, I ſhall examine it a little more particularly. NAT. HIST.

And firſt, there is no abſurdity to ſuppoſe, that if there be a ſeminal and plaſtic power in mineral bodies, it may be harbour'd in liquid principles as well as others; for we ſee that the ſeed of animals, which often, as in the elephant, the rhinoceros, *&c.* produces hard ſolid bones, teeth, and horns, is at firſt but a liquid ſubſtance; and the forming power in ſome trees and their fruits, converts the alimental juice into wood, ſhells, and other very ſolid, and ponderous bodies.

Secondly, in accounting for the figures of alum, vitriol, and other ſalts, that are curiouſly and geometrically ſhaped, there is no neceſſity to introduce a diſtinct, architectonic principle; ſince thoſe bodies may receive their ſhapes from the coalition of ſuch ſingly inviſible corpuſcles, as by the motion of the fluid, wherein they floated, and other aſſiſtant circumſtances, are determined to ſtick together, rather in that manner than another. Thus a ſalt made from common ſalt, by the ſingle aſſiſtance of oil of ſulphur, or of vitriol and water, tho' manifeſtly a factitious body, wherein the ſea-ſalt has its own nature deſtroyed yet by reaſon of the figure of the reſulting corpuſcles, and their fitneſs to convene, when diſſolved in water, into curiouſly ſhap'd bodies, will, when rightly prepared, often ſhoot into long cryſtals, with points like diamonds, reſembling native cryſtal as well in regularity of ſhape, as tranſparency of ſubſtance. And that 'twas partly the figure produced by the operation of the oil of vitriol upon the ſea-ſalt, and partly other circumſtances, that determined the ſhapes of the cryſtals, appears from hence, that when the quality or proportion of the oil of vitriol, was different from what it ſhould have been, or any error was committed in ſome part of the operation, the ſaline concretions, tho' they did not ſhoot at all like cubes, as the ſea-ſalt, which they were made of, wou'd alone have done; yet they ſhot very unlike rock-cryſtal, tho' into cryſtals for the moſt part very finely and differently figured. And that the natural figure of the ſea-ſalt is no way neceſſary to ſuch configurations, is manifeſt from this experiment. I took ſome ſtony *Stiriæ*, found in caves and grotto's, whoſe petreſcent liquors coagulate, before they have time to fall down; and having diſſolved them in ſpirit of verdigreaſe, I put the clear ſolution to evaporate in a digeſtive furnace, after the ordinary manner; by which means, tho' I made the experiment more than once, I had rather a coagulated maſs, than any thing like cryſtals; whence it appears, that a conjunction of ſeveral circumſtances may be requiſite to determine the figuration of conſiſtent bodies made out of fluids; ſince here, for want of time to make occurſions enow for the particles to concrete after the moſt convenient manner, the experiment ſucceeded not. Upon allowing many days to another ſolution of the *Stiriæ*, made in the ſame menſtruum, there ſhot about the ſides and bottom of the

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glaſs a number of diſtinct cryſtals, long, tranſparent, and curiouſly ſhaped.

Perhaps 'twill be ſaid, that the petreſcent juice, when broken, often appears to abound on the inſide with narrow ſtreaks like thoſe of antimony; and that I myſelf have obſerved ſome gems to be made up of thin plates; which internal figuration ſeems much more difficult to be accounted for, without a plaſtic form, than the external.

But, for ought I find, many known ſalts wou'd, when broken, appear to be geometrically figured, even in their leſſer corpuſcles, as well as in their entire bulk; if we had eyes ſharp enough to diſcern the ſhapes of the minute, as well as of the larger bodies. And we have great inducement to think, that the ſmall viſible concretions, of which the bigger grains of ſalt conſiſt, are as well as the greater, of a cubical figure. Beſides, there are ſeveral bodies ſo luckily ſhap'd, that upon a ſlow coalition, they will convene into a multitude of manifeſt concretions; ſome of which conſiſt of ſtreaks, and ſome of flakes. Thus in the common ſal-armoniac, tho' confeſſedly a factitious body, upon breaking the bigger maſſes, great multitudes of ſtreaks are obſervable, like thoſe we uſually find in the broken *Stiriæ* of petrifying water. And I have prepared concretions, ſome of which conſiſted of ſalts alone, and others of ſalts and minerals, ſuch as ſtones or antimony, which look'd very like talc, being white bodies made up of a multitude of very ſlender ſtreaky particles, lying lengthwiſe one upon another. And as I have taken out of the earth many concretions, outwardly ſhap'd like a rhombus, and compos'd of a multitude of flat and extremely thin plates; ſo have I ſometimes imitated ſuch concretions by art. And tho' a ſolution of ſilver in purified *Aqua fortis*, uſually affords only a great company of ſmall, thin, and ſeemingly ſimple flakes, like ſcales of fiſh; yet having diſſolv'd a large quantity of the metal together, and ſuffer'd it to ſhoot leiſurely, and with due circumſtances, I obtained many cryſtals, which were geometrically figured without; and conſiſted of a multitude of exceeding thin flakes, orderly adhering to one another. And for a yet more pregnant experiment, to clear this objection; tin-glaſs, tho' a compact and ponderous body, conſiſts of many ſhining, poliſh'd flakes; yet I found, that if this mineral were melted, and ſuffer'd to cool of it ſelf, the diſpoſition of its component particles wou'd determine them to ſtick to one another in broad ſhining flakes; whereof many will lie upon the reſt, and ſome acroſs each other, at various angles, according as the matter happen'd in its ſeveral portions to be refrigerated. There are factitious bodies alſo, which afford us the like inſtances; as I have obſerved in mixtures of copper, iron, and other minerals; and very conſpicuouſly in good *Regulus martis ſtellatus*, whoſe internal parts may be found, by breaking it, to conſiſt of flat ſhining, poliſh'd flakes.

If it be urg'd, to ſtrengthen the foregoing objection, that ſome petreſcent juices concrete, even whilſt men are looking on; and yet our

ſtony

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diverſified by the figure and capacity of the veſſel, choſen for the purpoſe. Having, therefore, powder'd a ſufficient quantity of tin-glaſs, when 'twas well melted, and caſt it into a good pair of iron moulds, whoſe cavity was an inch in diameter, we thence obtained a bullet, which, being warily broken, ſeem'd, as we expected, to be made up of a multitude of little ſhining planes, ſo ſhap'd and placed, that they appeared orderly to decreaſe, as they were further removed from the ſuperficies of the globe; they were, likewiſe, ſo rang'd as to ſeem made up of a multitude of theſe rows of planes, reaching every way, almoſt like ſo many *radij* of a ſphere, from the center to the circumference. But if tin-glaſs be melted in a crucible, and ſuffer'd to cool there, the matter, when taken out and broken, will appear, indeed, full of ſmooth planes, but, as was lately intimated, very irregularly and confuſedly aſſociated or ranged.

This experiment we have, alſo, varied by caſting bullets of ſome other bodies, and particularly of the ſimple regulus of antimony, and with ſucceſs; tho' the texture hereby produced was not ſo uniform as in tin-glaſs. And by caſting melted ſulphur into a ſpherical body of about five or ſix inches diameter, and breaking it warily; tho' one wou'd think this an unlikely mineral to make any other than a confuſed concretion; it preſented us great fibres almoſt like little ſtraws; whoſe number and orderly ſituation afforded a conſiderable inſtance for my preſent purpoſe.

And having broken ſeveral marcaſites of a peculiar ſort, that were either roundiſh or almoſt of a cylindrical figure, to obſerve their internal ſtructure and qualifications; I found in ſome of them a great many rows of little planes, or glittering corpuſcles, reaching from the innermoſt parts to the external ſurface, and in thoſe that were cylindrical, to the outſide. Theſe ranks of gold-colour'd particles, in the ſeveral planes of the broken mineral, ſeemed like ſemi-diameters, iſſuing from a row of phyſical points of an imaginary line, lying almoſt like the axis of a cylinder; as if the cavities of the chalk or clay, where theſe marcaſites were found, had made the ſoil like a mould, wherein the matter of them being detained, whilſt 'twas in a fluid form, afterwards concreted like the bullets of our tin-glaſs, *&c.*

As to the uniformity of ſhape admir'd in gems, and which is thought to demonſtrate them to be form'd by a ſeminal and geometrical principle; I cannot find, upon a more attentive ſurvey, that it is near ſo great as men uſually imagine.

In ſeveral tranſparent gems it manifeſtly appears, as I lately noted, that the ſhape was, in a great meaſure, owing to the figure of the womb or mould, wherein the matter, whilſt liquid or ſoft, happened to ſettle. But in ſome other tranſparent and well figured gems, of the ſame denomination, and, ſometimes, growing very near one another, I have found, by a diligent inſpection, a manifeſt, and ſometimes a very conſiderable difference of ſhape, either as to the number,

figures,

figures, or bigneſs of the ſides that made it; by comparing theſe particulars with thoſe of a ſtone of the ſame kind perfectly figured. This I took notice of particularly, in two ſorts of ſtones, granats and *Corniſh* diamonds. A conſiderable number of the former, that grew in *America*, was brought to me in one lump of matter; but growing in diſtinct parts of it, and without touching one another. Among theſe I took notice of a manifeſt diſparity of ſhape; ſo I did in ſome *African* ones, as alſo in others that were *European*; one of which, being of an extraordinary large ſize for a figured gem of the tranſparent kind, and weighing above eleven drams and a half, I conſider'd, with a particular attention; and found, that tho' it ſeemed to have been coagulated in a fluid medium, and to conſiſt of twelve planes, at the concourſe of two or three whereof it ſeem'd to have been broken off from the root; yet it was very far from the geometrical dodecahedron; for as this conſiſts of twelve equilateral and equiangled pentagons, almoſt all the planes of our granats were quadrilateral, and very different from what they ſhould regularly have been, not only in magnitude, but in ſhape; for one of them ſeemed to have five ſides; and for the reſt, ſome were neareſt to a rhombus, others to a rhomboides; but the moſt were trepezia. And, by the way, a curious perſon ſhewed me a pearl very irregularly ſhaped, and of an enormous ſize. It was ſo artificially ſet in gold, that by the help of a little of that metal, fitly placed, the whole jewel repreſented a lion; yet I made a ſhift to meaſure it exactly with collapar compaſſes, and found the length to be an inch and a half, and the greateſt breadth, where it was of a proportionable thickneſs, to be $\frac{4}{5}$ inch. The colour was orient enough, except one dark ſpot, which by its ſize, figure, and ſituation, I gueſſed to be the remains of that part whereby 'twas faſten'd to the ſhell of the fiſh which produced it. And thus much for the firſt ſort of gems, whoſe figures I obſerv'd to be irregular. NAT. HIST.

The ſecond conſiſts of thoſe cryſtalline ſtones, ſome of which are much harder than the *Briſtol* diamonds; or, perhaps, than rock-cryſtal it ſelf; for 'tis eaſie to write upon glaſs with them. Having procured a large number of theſe ſtones, I took notice, by comparing them together, that tho' ſome of them were geometrically and curiouſly ſhap'd like rock-cryſtal, having each ſix ſides, whereof two, that were oppoſite, ſeem'd perfectly alike and equal; and tho' the ſtone had a pyramidal termination, made up by ſeveral reſembling and curiouſly figur'd planes, that ended in a ſolid angle; yet the greateſt number, by much, of theſe diamonds, conſiſted of ſtones whoſe figures were far from exact and uniform. For tho' moſt of them had ſix long planes, yet often the oppoſite ones were neither parallel to one another, nor ſimilar, but exceedingly unequal; and thoſe planes that went to make up the apex, compared with one another, or with regular patterns, their figures, magnitudes, and manner of concurring, were ſo remote from uniform, as to agree far better with our hypotheſis than with

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the other. And yet the want of room to coagulate freely, could not, with probability, be here pretended; for they ſeem'd to have been form'd ſeparately in a fluid ambient, except at the bottom, where they were faſtened to the rock; as appeared by an opake root which ſtill adhered to moſt of them. And, if I miſremember not, I have more than once, on diamonds newly brought from the *Indies*, and ſome of them very fair ones, obſerved great irregularities in the area's of the ſuperficial planes, or in their figures, or both; and, ſometimes, in the very number as well as ſituation of their ſolid angles.

I now proceed to ſhew, that the figuration of gems not only conſiſts with our conjectures, but confirms them; for I have, more than once, taken notice in *Corniſh* diamonds, that a ſmall ſtone, of the ſame kind, has made, as it were, one body with a greater; not only adhering cloſely to it, but being bedded in it; ſo that when they were ſeparated, there remained a cavity in the larger, whoſe figure exactly anſwered that of as much of the ſmaller ſtone as chanc'd to be lodg'd therein. Thus, alſo, I have ſeen a greater grow to a much leſs; there being a cavity in the latter anſwerable to the part of the greater that had enter'd it; which ſeems to ſhew, that the ſtone to which the other grew, was firſt form'd and harden'd, ſince it retain'd its own ſhape; and that whilſt this adhered to the rock or ſoil, more liquor began to coagulate, by faſtening it ſelf to the ſolid body, which was already concreted. Thus by putting into a ſtrong ſolution of pure nitre, or rock-alum, ſome little ſticks of wood or other ſolid body, that may be kept ſteadily in the ſame poſture, you will ſee many coagulations begin to be made againſt them; and the cryſtals, thus concreted, will neceſſarily have their figures incompleat, and cavities correſpondent to thoſe parts of the ſtick whereto the ſaline corpuſcles faſtened. And tho' I inſtance this inoſculation of figured ſtones but in *Corniſh* diamonds, yet thoſe are not the only tranſparent minerals wherein I have obſerved it. And particularly, I found among a parcel of minerals, a fine tranſparent and neatly figured ſtone, which ſeem'd to be pure cryſtal; but lay coagulated about a kind of branching wire, whereof a great part was encloſed by the ſtone, ſeem'd to grow out of a piece of ore, reſembling that of ſilver; which the owner affirmed to be, together with the above mentioned branch, good ſilver, produced by nature in that form; which excellently agrees with the reſemblance I juſt propoſed, betwixt the coagulation of diſſolved ſalts and the liquid matter of gems, about ſtable bodies immerſed therein.

A greater ſpecific gravity in gems argues their metalline or mineral nature.

But to proceed. The ſecond grand conſideration, whereon our hypotheſis is founded, ariſes from the weight of ſome gems, which, being greater than what ſeems to belong to them, as hard tranſparent ſtones, we may, probably, derive it from metalline or mineral mixtures. Gems are eſtimated by lapidaries as they weigh a determinate number of carrats, or of grains; for they compare only the weight of ſtones of the ſame kind, to one another, as the greater or leſſer weight argues a greater or leſs bulk;

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

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the ſardonyx, *&c.* not to mention the ſemi-opake. Beſides, I much queſtion, whether tranſparency be abſolutely eſſential to thoſe precious ſtones, wherein 'tis uſually found. And I might here make it probable, that opacity and tranſparency often depend upon the manner wherein the pigment is diſperſed thro' the ſtony matter of the gem; and the convenient or inconvenient ſituation of the pores, with reſpect to the rays of light. Moreover, ſeveral precious ſtones, and even diamonds themſelves, have ſometimes great clouds, which render them in thoſe parts opake, without hindering them from being true diamonds or gems, of this or that kind, to which their hardneſs, colour, *&c.* entitles them; and not to obſerve that cornelians, agates, and ſome other ſtones, are ſometimes found to be tranſparent, and ſometimes ſemi-diaphanous, I have ſeen even a ſardonyx tranſparent. And as for granats, I have had ſome figured ones that ſeemed quite opake; and others of ſeveral countries, that were in ſome places diaphanous, but as to the main bulk of their bodies almoſt as dark as ordinary ſtones.

And there is no doubt, that the experiments, whereby I have obtained mineral or metalline ſubſtances from load-ſtones, native cinnabar, blood-ſtones, *&c.* might alſo ſucceed in ſeveral of the more ponderous gems; if their glaſſy nature, or the exceeding compactneſs of many of them, rendered not the mineral corpuſcles harbour'd in the ſtony, or inſoluble parts, inacceſſible to the common menſtrua. And when the metalline and mineral ingredient is in great plenty, and the tincture of the ſtony parts not very cloſe; I queſtion not but even from tranſparent gems, the adventitious ingredient may in part be diſſolved: for having by the weight of the granats lately mentioned, concluded them impregnated with ſomewhat metalline; I kept ſome of them in a crucible for a competent time in the fire, and found they thereby exchanged their colour for one not unlike that of rough iron. And having reduced them to a very fine powder, and digeſted ſome acid menſtrua, and particularly rectified ſpirit of ſalt upon them, they afforded me a rich tincture. Encouraged by this, I hoped, that without being previouſly burnt, they wou'd in *Aqua regia* afford a tincture; and accordingly I obtain'd from crude granats, (reduced to very fine powder) a rich ſolution, which tho' in colour it ſomewhat reſembled a ſolution of gold; yet partly by the colour of the burnt granats, and partly by the taſt of this ſolution, I ſuppoſed that another metal was more likely than gold, to be predominant therein. And having gently evaporated part of that menſtruum, I obtained from ſome of the remainder certain cryſtals, whoſe ſhape, by reaſon of their ſmallneſs and diſorderly coagulation, I cou'd not well determine; but, touching the uncoagulated portion of the liquor with the tip of my finger, and adding that part of a drop which reſted thereon, to a great many drops of the infuſion of galls, it inſtantaneouſly turn'd them full as black as ink.

This

This trial I made to examine, whether one mineral, at leaſt, that helped to conſtitute theſe granats, was not of a feruginous nature; for if it were, I ſuppoſed, like other bodies that participate of iron, it would afford, with galls, an inky colour. A parcel, alſo, of ſmall red tranſparent ſtones, gueſſed by ſome to be granats, but by others, more probably, rubies, being finely powdered, gave, in an appropriated menſtruum, a colour like that of diſſolv'd gold; and that ſome parts of the gems were really diſſolv'd in the menſtruum, appear'd not only by the colour; but having put ſome of this liquor to a tincture of galls, it produced, at the very firſt, a dark colour, tho' not near ſo black as that of the former granats; and immediately let fall a copious precipitate, that was almoſt white. I, moreover, precipitated from it, by an urinous ſpirit, a reddiſh ſubſtance; which being ſuffer'd to dry in the air, ſeem'd to grow into bodies ſhap'd like moſs; and here and there ſmall muſhrooms, all of them prettily coloured. And from certain granats that were in ſome places opake, as well as in others diaphanous, I obtained a ſolution; the ſuperfluous liquor whereof being abſtracted, the reſidue, which was deeply coloured, did, in the cold, afford a kind of ſaline concretions; tho' not large enough to have their figures determined. NAT. HIST.

And, perhaps, if men had the curioſity to make trials, there wou'd be other tranſparent minerals found, capable to be wrought on by appropriated menſtrua. For I do not think that every ſeeming glaſſy contexture of a mineral, unfits it for that purpoſe. Tho' the clear ſpar, which, in moſt of our weſtern lead-mines in *England*, is found next to the metalline veins, be at leaſt ſemi-diaphanous, and of ſo glaſſy a texture, that it uſually breaks into ſmooth and gloſſy ſuperficies, appearing like a talc; and is, alſo, for the moſt part made up of geometrically figured bodies, reſembling in their ſurfaces, a rhombus, or rhomboides; yet ſome other experiments I had made with it, inducing me to ſuſpect, that 'twas not indeed a talc, but a body of a much more open texture, I found I cou'd diſſolve it in ſeveral liquors; and particularly in good ſpirit of ſalt, which wou'd preſently work upon it, even whilſt it remained in lumps; and that too without the aſſiſtance of heat.

But from what I have ſaid as to the uſefulneſs of menſtrua, it muſt not be inferr'd, that they are the only inſtruments wherewith ſomething metalline may be obtained from gems; for I have made conſiderable attempts of this kind by fuſions, and appropriated additions. And, however ſuch trials may ſucceed, as to the ſeparating from a gem, a metalline or mineral body of a determinate ſpecies, I have an eaſie way, in which, by the help of fuſion, I more than once manifeſted, in general, that there may be ſubſtances partaking of a metalline nature, in ſome kinds even of tranſparent gems; and partly by the ſame method, and partly by others, I have in ſome caſes determined, with probability, that mineral ſubſtance is here predominant.

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It may ſerve to illuſtrate our hypotheſis, that having reduced to powder ſome *Stiriæ* of water, ſpontaneouſly petrified, diſſolved it in ſpirit of verdigreaſe, ſuffered ſome of it to evaporate, and put the reſt into a cool place; I obtained many ſmall, finely figured, and tranſparent cryſtals, that ſhot much after the faſhion of thoſe of the purer ſort of nitre. With ſome part, alſo, of this ſtony ſolution, I mixed, in a convenient proportion, a high-coloured ſolution of copper, made with the ſame ſpirit of verdigreaſe; and the two ſolutions being warily put together, did not precipitate one another, but afforded, upon the evaporation of their ſuperfluous moiſture, among many cryſtals, that were tranſparent and colourleſs, ſome that were richly adorned with a greeniſh blue tincture of the diſſolved metal.

SECT. II.

I Now proceed to thoſe conſiderations, which, aſſiſted by what has already been delivered, may ſuffice to ſhew our conjecture, as to the cauſe of the virtues of gems, to be rational.

Mineral productions exceeding numerous in the bowels of the earth.

My firſt obſervation is, that the earth not only contains a great number and variety of minerals, known by particular names, but very many others wherewith we are hitherto unacquainted. What a vaſt multitude of metalline ores, marcaſites of ſeveral ſorts, antimonies, tin-glaſs, *Fluores*, talcs of various kinds, ſpars, ſulphurs, ſalts, bitumens, *&c.* are mentioned by chymiſts and mineraliſts, in the accounts of repoſitories, and collections of natural rarities? Nay, the diligence of ſome modern writers hath reckoned up between two hundred, and two hundred and fifty foſſils of the ſame kind.

The ſecond part of our obſervation appears, from conſidering the very ſmall proportion that the perpendicular depth of the generality of mines, bears to the ſemi-diameter of the earth; ſo that tho' our globe were inhabited by ſome hundred millions of men more than now it is, and they had the curioſity to dig mines every where, their ſpades wou'd uſually penetrate ſo little a way into the earth, that a vaſt multitude of foſſils might, by lying deeper in the bowels of it, ſtill continue undiſcover'd. And, as far as I have obſerv'd, almoſt every region hath peculiar minerals, different from thoſe of other countries. Thus in ſome counties of *England*, a curious eye may, doubtleſs, obſerve ſeveral, that are unobſerved by the inhabitants themſelves; eſpecially if well contriv'd borers were diligently and ſkilfully employed to pierce the ground, and bring up ſamples of the various foſſils that lie hid under it. And this I can my ſelf ſay, in general, that in ſome parts of *England*, where I had more opportunity than in others, to exerciſe my curioſity about minerals; I have, in a ſmall

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NAT. HIST.

der'd ſome of the vegetable ſubſtances, found there, of their priſtine ſhape and bigneſs, hard enough to cut both glaſs and iron. And from among theſe I pick'd a tranſparent body, that by the ſhape and other circumſtances I judg'd to have been a diaphanous gum, belonging to a piece of petrified wood, which was hardened to a degree that made it capable of ſcratching glaſs.

Their virtues, whence?

To apply theſe particulars to our ſubject: I conceive that ſome of the real virtues of gems may be derived from hence, that whilſt they were in a fluid form, the petrefcent ſubſtance was mixed with ſome mineral ſolution, tincture, or other impregnated liquor; and that theſe were afterwards concoagulated, or united and hardened into a gem. And as ſeveral virtues of gems may, in general, be deduced from the commixture of theſe mineral corpuſcles; ſo the greatneſs and variety of their particular virtues may proceed from the peculiar nature of the different impregnating liquors, and from the proportion wherein they are mix'd with the petrefcent juice.

To render this conjecture the more probable, it muſt be remembered, that we have already ſhewn gems to have once been fluid or ſoft bodies; and that ſeveral of them were not ſimple concretions of a petrefcent liquor, but conſiſted alſo of other mineral adventitious parts; as appears from the ſeparableneſs of ſuch ſubſtances in ſome ſtones, the ſpecific gravity in others, and the different tinctures to be met with in gems of the ſame ſpecies, as rubies, ſapphires, granats, and even diamonds; of which, as I formerly ſaid, I have ſeen ſome yellow, ſome of other colours, and ſome green, almoſt like emeralds.

Since, then, there may be in gems, and in ſome of them numberleſs adventitious corpuſcles; ſince there is cauſe to think, that ſome of them may be endowed with ſeveral properties and medicinal virtues; ſince there is a great difference among theſe impregnating particles, and, probably, a greater variety than is known to us; and, laſtly, ſince many gems are richly impregnated with theſe particles, I ſee no reaſon why ſome of the virtues of ſeveral gems may not proceed from hence, rather than from thoſe unintelligible and precarious ſubſtantial forms to which they are uſually referr'd.

Whether gems have, really, any medicinal virtues?

It may, however, be objected, that the mineral ſubſtances cannot well have any medicinal operation on the human body, becauſe they are ſo lock'd up as to communicate nothing to it; being unconquerable by ſo ſmall a heat as that of the ſtomach, and other parts. Now, if there had never been any actual trial made, to ſhew whether a gem be capable of medicinal virtues, I ſhou'd find probability enough in this objection, to ſuſpend my judgment till experience determined the queſtion. But ſince, upon very credible teſtimony of eminent phyſicians, and patients themſelves, of my own acquaintance, I find cauſe to aſſent to ſome matters of fact about the operation of gems; and ſince ſuch facts ſtrongly argue, in the general, that a precious ſtone may have medicinal virtues, I think the objection ſufficiently

ently enervated by ſuch particular inſtances; ſo that it ought not to keep us from aſſenting to the poſſibility of the thing, eſpecially when there are other particulars to be alledg'd in favour of our hypotheſis. For vigorous load-ſtones emit copious effluvia; and tho' they are uſually a hard ſort of ſtones, I have met with ſome, poſſibly, much harder than ſeveral gems. And 'tis farther conſiderable, that there are magnets which have a manifeſt and inconvenient operation upon the human body, by being wore in the pocket, or long held in the hand. NAT. HIST.

But farther, I have found ſeveral tranſparent pebbles, ſome of which, by being barely well cut and ſet, are made to counterfeit diamonds, that may immediately be brought to emit copious and ſtrong ſcented ſteams. And if electrical attractions be owing to the effluvia of bodies, excited by rubbing; very ſlight alterations may ſuffice to procure expirations from tranſparent gems, many of which are electrical, and even the hardeſt of them, diamonds themſelves; one of which I keep by me, that upon a little friction attracts very vigorouſly.

And as to that part of the objection which pretends, gems are not to be digeſted by the heat of the ſtomach; I will not ſtay to examine how far the digeſtion of things, in the ſtomach, is owing to heat. But to make the objection valid, it ſhould be firſt proved, that ſuch materials can have no operation upon the human body, while they paſs thorough it, without undergoing any ſenſible change of bulk, figure, *&c.* as gems, when ſwallow'd, are ſuppoſed to do. For ſome chymiſts make bullets of the regulus of antimony, which they call *Pilulæ perpetuæ*; becauſe when they have perform'd their operation in the body, and are thrown out with the excrements, they may be employed again and again to the former purpoſe: nor do we know what analogy there may be between ſome juices in the body, and thoſe parts of mineral ſubſtances that impregnate gems. For tho' the *Oculus mundi* is reckon'd among the rare gems, yet if one of the beſt ſort be, for a while, kept in common water, it will, as experience aſſures me, receive an alteration obvious to the eye. I might here alledge the concurrent authority of many phyſicians, and the common practice of moſt, who, in their public diſpenſatories as well as private preſcriptions, order the fragments of precious ſtones to be taken inwardly, upon account of the virtues aſcribed to them. But I wave ſuch arguments as ſeem ſuſpicious. However, I myſelf have, without heat, obtained a manifeſt tincture from ſeveral hard bodies, and even from a tranſparent ſort of gems, by means of a faint liquor diſtill'd from a vegetable ſubſtance, which is as temperately qualified and as plentifully eaten as bread. And whether ſome juices of the body, aſſiſted by the natural heat thereof, may not ſerve for menſtrua to ſome gems, I cannot with certainty ſay. But even the natural heat of a human ſtomach, nay, perhaps, of the external parts of the body, may be able, tho' not to digeſt precious ſtones, yet to fetch out ſome of their virtues; ſince, I am ſure, it makes a ſenſible alteration in the hardeſt ſort of them. For I have a diamond,

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diamond, whoſe electrical faculty may be excited without rubbing, only by a languid degree of adventitious heat; and had in keeping another, which, by means of water made a little more than luke-warm, I could bring to ſhine in the dark.

If it be further alledg'd, that tho' ſome virtues be allow'd to gems upon account of the minerals that impregnate them, yet 'tis impoſſible thoſe virtues ſhould be very great and various: I reply, that I deſire no man to believe all the ſtrange things, that even ſome learned writers aſcribe to ſuch ſtones; for the rarity of tranſparent gems, their luſtre, and the great value which their ſcarcity, and mens folly give them, emboldens ſome to ſay, that ſuch ſcarce and noble productions muſt be endowed with proportionable qualities.

But for a further anſwer to this objection, 'tis not improbable that there ſhould be in the earth a much greater variety of minerals diſſoluble by the ſubterraneal menſtrua, and capable of coagulating with petreſcent juices, than authors have yet taken notice of; as many ſubterraneal productions, that I have met with, ſtrongly incline me to believe. And from the number and various mixtures of theſe, may proceed not only a great variety of operative particles in precious ſtones, but a high degree of energy in ſome of them.

Next, I conſider, that the efficacy of thoſe mineral tinctures, or ſolutions, already known to us, may be reaſonably preſum'd greater in ſome gems, whereof they became ingredients whilſt *in ſolutis principiis*, than can be expected from the vulgar ſolutions of the ſame metals or minerals, after they have, by vehement fires, been reduced into gold or ſilver, lead or antimony, *&c.* For in ſuch vehement fuſions as are requiſite to bring metalline ores into theſe ſubſtances, the volatile and ſpirituous parts will be driven away, and the remaining body become more hard and compact, and thereby have its virtues lock'd up. But in their ſtate of fluidity, thoſe ſubtile and efficacious parts are preſerv'd and united to the other ingredients of the gems, whence ſome of them may be eaſily drawn out; as I lately inſtanc'd in very hard pebbles, which afforded ſtrong ſcented effluvia. And from the greater or leſs plenty, and natural activity of the impregnating particles in a gem, may, probably, be deduced the difference of the colour in ſome, and of the virtue in others of the ſame denomination: of the latter caſe, we have eminent examples in ſome learned writers; particularly in the *Lapis nephriticus.*

And here we may obſerve, that the petreſcent juices themſelves may have diſtinct natures, and be endowed with peculiar qualities, abſtracting from thoſe they acquire, upon account of their coalitions with adventitious liquors; as ſome differences I have found in petreſcent fluids make probable. And having obſerved petrifying liquors or ſpirits, to pervade and give a high degree of hardneſs to bodies that chanced to lie within their reach, tho' one would have thought them ſufficiently indiſpoſed to receive ſuch an induration; I ſee no abſurdity

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might imbue it with conſiderable virtues. But, by the way, it is not neceſſary that the adventitious ſubſtance ſhould be purely ſaline, to cauſe no alteration in the tranſparency of cryſtal, or the colour of other gems. For I have often made bodies, which, tho' tranſparent and colourleſs, like cryſtal, and ſometimes curiouſly and regularly figured, were yet of a compound nature; and particularly abounded with a ſtrongly ſcented ſulphur that was eaſily ſeparable therefrom. But, to give a more direct anſwer to the objection, I ſhall add, that tho' when a gem has a much greater ſpecific gravity than cryſtal, or will allow an adventitious mineral to be ſeparated from it, 'tis a very probable argument, that the petreſcent juice is that body compounded with another ſubſtance; yet it will not neceſſarily follow, when neither of theſe ſigns appear, that the gem is quite free from ſuch a ſubſtance. For the petreſcent liquor, whereof it principally conſiſts, may be impregnated with the finer and more ſpirituous part of the mineral, without having its ſpecific gravity ſenſibly increaſed. Of this I received a notable inſtance from a mineral water; for tho' that water, by its inky taſt, by its colouring the excrements of thoſe who drank it, *&c.* appeared greatly to participate of iron; yet the particles of that metal were here ſo light and ſpirituous, as not only to fly away if the liquor were kept negligently ſtopped; but examining it hydroſtatically, when freſh drawn, I found it very little, if at all heavier in ſpecie, than common water, compared and examined in the ſame ſcales, after the ſame manner, and with the ſame exactneſs.

If to all this be added, a conſideration drawn from the atmoſpheres of ſolid bodies, and the great efficacy of effluvia, it will appear but natural to ſuppoſe, that ſome precious ſtones may have medicinal virtues; and that many of them may be aſcribed to the mineral ſubſtances whereof they participate or conſiſt; and eſpecially to thoſe which are beſt fitted to exert their powers, by a copious efflux of their more ſubtile parts.

'Tis true, what has been hitherto delivered, chiefly regards tranſparent gems; yet a great part of it may be apply'd to opake ones. And if I have ſhewn, that even diaphanous gems may be endowed with virtues, by the mineral ſubſtances they contain, the arguments will hold more ſtrongly as to opake gems; for theſe are, for the moſt part, ſofter than the others; and 'tis far more eaſie to ſhew, by their ſpecific gravity, and the mixed nature of ſeveral of them, that the dark ones may greatly conſiſt of mineral ſubſtances, incorporated and hardened with petreſcent juices. And among the ſeveral kinds of theſe liquors, I have obſerv'd one of ſo fine a ſubſtance, yet of ſo petrifying a virtue, that it will penetrate bodies of very different kinds, and turn them to ſtone, without ſenſibly increaſing their bulk, or changing their ſhape or colour. By this means, I have ſeen ſeveral animal and vegetable ſubſtances ſo petrified, as ſcarce to be diſtinguiſhed, by their appearance, from natural. Thus, for inſtance, a thin cream cheeſe was turned into ſtone, whilſt the ſize, ſhape, and

Animal and vegetable ſubſtances petrified, whilſt their forms appear'd unalter'd.

colour,

colour, even of the wrinkles, and the bluiſh mould, were ſo well preſerved, that it might eaſily have been thought eatable. I have alſo had a conſiderable quantity of wood ſo petrified in *England*, which retaining its former figure and grain, and being ſcarce at all viſibly increas'd in bulk, was ſo very hard, that I cou'd make impreſſions with it upon iron, and even glaſs it ſelf, and ſtrike fire with it, as if it were an excellent flint: and the ſtony parts hereof wou'd not ſuffer the wood, which they had penetrated, to be reduced in the fire either to aſhes or charcoal. I have likewiſe now by me a lump of mineral ſubſtances, wherein a petreſcent liquor, that fills the large intervals between them, is tranſparent, and harder than moſt ſtones; as far as we cou'd gueſs by ſome trials made upon it, by a ſkilful engraver of gems. NAT. HIST.

'Twere eaſie to add other inſtances of this kind; but theſe may ſuffice to ſhew it poſſible, for petrifying agents to inſinuate themſelves into the pores of various bodies, and turn them into ſtone; without otherwiſe deſtroying their priſtine nature, or ſo much as altering their figure.

And now, to render our hypotheſis the more probable, I ſhall offer a few arguments, drawn from the great ſpecific gravity of ſeveral opake, medicinal ſtones; from the fitneſs of our ſuppoſition to account for ſeveral phenomena, ſome of which are ſcarce at all, and others much leſs probably to be accounted for without it; from the metalline ſubſtances, manifeſtly to be obtain'd from the ſtones we are treating of; and laſtly, from the nature of the bodies whereof medicinal ſtones ſeem to be compoſed.

Opake ſtones, examin'd hydroſtatically, and thence ſhewn to be mixed with mineral ſubſtances.

1. That the ſpecific gravity of opake ſtones, whereto medicinal properties are aſcribed, is very conſiderable, might have been eaſily diſcovered from hydroſtatics, if the writers upon ſuch concretions had been vers'd in that doctrine. Now, as marble is generally allowed to be a pure and ſolid ſtone, and, upon account of its whiteneſs, likely to be free from mineral mixtures, I choſe that for the ſtandard of the ſpecific gravity of opake ſtones; and, accordingly, having weighed a piece of it, in air and in water, I found it to be to an equal bulk of that liquor, very nearly as $2\frac{1}{10}$ to 1. And to make trial in a ſtone uncoloured, but ſuppos'd of a cloſer texture, we examined a fine white pebble, and found it was to an equal magnitude of water, as $2\frac{6}{10}$ to 1. Hence 'twas eaſie to infer, that ſeveral bodies, which commonly paſs for mere ſtones, are more ponderous than white marble of the ſame bulk; and that if there were any great exceſs in the ſpecific weight of ſtones, above that of marble, it might proceed from ſome metalline body, mixed with the petreſcent matter thereof. And I ſoon found, by weighing the following minerals, firſt in air, and then in water, that a blood-ſtone was to an equal bulk of water, as $5\frac{1}{10}$ to 1; the load-ſtone as $4\frac{6}{10}$ to 1; *Lapis Calaminaris* as $4\frac{7}{10}$ to 1; and *Lapis Tutiæ* very near as 5 to 1.

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But I have not found the proportion of each of theſe bodies to water, to be any thing near conſtantly the ſame; but ſometimes to differ very much in particular ſtones of the ſame kind; which agrees very well with our hypotheſis: for, according to that, the ſtones which happen to partake more plentifully of mineral ſubſtances, heavier in ſpecie than ſtone, ought to be more ponderous than others of the ſame kind that are not ſo qualified. From jet, a foſſil found in ſome parts of *Europe*, which is reckoned among ſtones, and worn by many as a gem, I obtained no inconſiderable proportion of oil; and having weighed choice jet it ſelf in water, I found it to be bulk for bulk to that liquor, but as 1 $\frac{22}{100}$ to 1. And there are ſome other foſſils, hard as ſtone, and poliſhable as marble, from which I have, by diſtillation, obtained two kinds of oil, whereof one was lighter than common water; which ſhews, that even bituminous and light ſubſtances may be ingredients of a ſtone: and that ſalts, which are moſt of them lighter in ſpecie than white marble, may plentifully concur to the making up of ſtones, will appear from thoſe, whereof we in *England* make vitriol. Stones, therefore, which are lighter in ſpecie than white marble, may be compounded of foſſils, and thence derive peculiar qualities; at the ſame time that ſuch as are conſiderably heavier than that, may juſtly allow us to ſuſpect, they owe their gravity to the mixture of metalline or mineral ſubſtances.

The manner wherein gems and ſtones are found to grow.

2. I have learn'd of travellers returned from the *Eaſt-Indies*, that ſometimes one ſort of tranſparent gems, ſometimes another, and ſometimes even diamonds themſelves, are found included in the rocks, or in the midſt of hard, looſe ſtones, which muſt be broken in pieces before they can be obtained. Which phenomenon is hard to ſolve without our hypotheſis; but according to that, it may rationally be ſuppos'd, that the gem was firſt formed, either in earth, or ſome other ſoft and permeable ſubſtance; which being afterwards pervaded by ſome petrifying juice, was turn'd into rock, or looſe ſtones, according as the earth, and other ambient matter, chanced to be an entire and coherent maſs, or divided into clods, and parcels. And the governour of an *American* colony having ſent me, among other curioſities, an odd kind of mineral, that ſeemed more ponderous than at firſt ſight it promiſed; I had the curioſity to break it, and found up and down therein ſeveral gems; which, by their figuration, and ſome other circumſtances, were concluded to have been form'd there, before the ambient mineral had obtain'd the nature it then appear'd to be of. And it may happen in opake ſtones, that a great lump of medicinal earth ſhall be invaded and petrified after the ſame manner. Whence it need not ſeem ſtrange, that ſome medicinal ſtones ſhou'd be very large in compariſon of others. Thus I remember, a phyſician told me of a ſpleen-ſtone in the hands of an acquaintance of his, which weighed 80 *l*; and I have ſeen lumps of medicinal ſtone, much hard-

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had bēen ſome thin ſeparate beds of fine clay or earth, lying almoſt parallel to each other; which, by a petreſcent liquor that ſettled there, was reduced to coagulate with it into a ſtone, partly opake, and partly diaphanous. And of ſuch clays or mineral earths, I have obſerved more than one or two, which, tho' diſtinct, and, perhaps, of different colours, yet the thickneſs of them all ſcarce exceeded an inch; nor did they always lie flat or horizontally, but in differing poſtures, both with regard to the horizon and one another; and now and then the exterior ones, ſucceſſively, almoſt ſurrounded the inferior. And of theſe thin couches or layers of earth, I have found a conſiderable number within a very ſmall compaſs of ground. The production of ſeveral other gems, as chalcedonians and jaſpers, which are generally opake, but have ſome parts tranſparent, may alſo, probably, be explain'd in the ſame manner. 'Tis here remarkable, that by purpoſely calcining ſome of theſe ſtones entire, whoſe greater part was diaphanous, I found that the tranſparent parts turn'd white, and that ſome of the thin couches of mineral earth had retain'd, not only their poſition, but their colour, which ſeem'd much heighten'd; ſo that one of theſe layers, after calcination, appeared of a very rich and permanent red. And this difference of colours, I obſerved, not only in layers, but in the ſpecks and irregularly ſhap'd clouds of other colours. I might here add, that I have found ſhining marcaſites, not only in other ſolid ſtones, but in marbles and flints themſelves. Thus, alſo, I have found wood in ſtrong ſtones employed to build houſes, and ſhells in a great maſs of ſtone, that I met with almoſt on the top of a hill, remote from the ſea. Now theſe, and the like phenomena, may be, probably, accounted for by our hypotheſis, and ſcarce without it. But even in tranſparent gems, and which is more, of the ſame ſpecies, I have ſometimes taken notice of ſuch an accretion of ſtones as argues their having been produced at ſeveral times. For proof of this, I need only repeat what I formerly ſaid of thoſe *Corniſh* diamonds, wherein, ſometimes, a leſſer ſtone, tho' geometrically ſhap'd, was found in good part inclos'd in a greater, and in part, alſo, extant above it; whence I argue, that the production of this aggregate of two cryſtalline bodies, was not made all at once, but ſucceſſively; and that the leſſer was firſt formed; which I ſhall now confirm by this conſideration; that if the greater ſtone had been firſt harden'd, the matter of the leſſer muſt only have ſtuck to it externally, and been, as it were, imboſs'd upon it; but cou'd not have made it ſelf a bed, or mould, in the ſubſtance of the greater, eſpecially of ſuch a geometrical figure as it ſelf had not yet receiv'd.

I cauſed two ſolid fire-ſtones, ſuppoſed to be uniform and entire maſſes, tho' of very different ſizes and ſhapes, and brought from diſtant places, to be warily broken; whereupon I obſerved that part of the internal texture of the leaſt of theſe minerals, which was almoſt ſpherical, greatly differ'd from that of the more internal ſubſtance; and

that in the largeſt mineral there was a little globular ſtone, manifeſtly not of the ſame piece with the ſurrounding maſs, but differing from it, not only in texture, but here and there by a diſcernible commiſſure; tho' in moſt places their adheſion was ſo ſtrict, that we could not make any ſeparation of the two minerals in this commiſſure.

And tho' this ſucceſſive generation of the parts of entire gems, may appear ſomewhat new and ſtrange; yet that its fitneſs to explain the foregoing phenomena, and others, may the more recommend it, I ſhall here give it a mechanical illuſtration. We ſee, then, in ſeveral chymical ſolutions, as of ſalt and other bodies, that there are certain ſtages or periods of coagulation; ſo that when ſuch a quantity of the ſuperfluous moiſture is exhaled, eſpecially upon any conſiderable refrigeration, or other favourable circumſtances, thoſe particles that are moſt diſpoſed to coagulation, will convene and ſhoot into cryſtals, after which, no more will ſhoot till a farther evaporation be made; but upon a repetition hereof, a new cryſtallization of the parts may enſue. And I can ſhew the productions of a metalline ſolution, ſo made in an appropriated liquor, that the firſt ſhooting afforded a layer of curiouſly figur'd cryſtals; and the following, another of fine cryſtalline bodies, that have faſtened themſelves to the former, but differ conſiderably from them both in ſhape and poſture. And in this experiment, both the diſſolved materials and the menſtruum, were ſingle bodies. But if there be a diverſity of nature in the liquors that make up a menſtruum, or in the bodies that are diſſolved in it, ſome of the corpuſcles may convene, either a-part with thoſe of the ſame nature, or as mix'd with thoſe of a different one at the ſame time; and ſo make up cryſtals of a compound nature. Some of them, alſo, may convene with homogeneous particles, at different times, and ſo fail of ſuch an uniformity as might otherwiſe appear in their concretions. This may be illuſtrated by the cryſtallizations of ſalt-petre and ſea-ſalt, diſſolved together in common water, whence grains of ſalt of the figures thence reſulting, are uſually produced; and, alſo, a conſiderable part of the ſea-ſalt coagulates in the form of imperfect cubes, about the bottom, before the nitrous corpuſcles ſhoot into cryſtals of their own priſmatical figure: and it matters not whether the ſuperfluous water be exhaled or drawn off by a material fit to ſoak it up; as we have had occaſion to obſerve in accelerating the cryſtallizations of ſome bodies.

In conformity with ſuch inſtances as theſe, we may conceive, that where there are petreſcent liquors mix'd with common water, there may by ſeveral accidents, and particularly by a hot ſummer, be made a ſufficient diſcharge of the ſuperfluous moiſture, to cauſe the more diſpoſed parts of the petreſcent liquor to coagulate; and afterwards the coagulation may be ſuſpended, either by the ſupervention of a colder ſeaſon, or even in ſummer it ſelf, by a plentiful rain, or the effect of it, a land-flood, which might check the progreſs of ſuch coalitions, by diluting the fluid which would otherwiſe have turned into ſtone.

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And trial hath aſſured me, that there are bodies of very different kinds, which will, in tract of time, eſpecially if their coalition be farther'd by cold weather, coagulate after they have long remained fluid; tho' the water, or other menſtruum, by being encloſed in ſtopped glaſſes, be kept from waſting. And ſince the earth harbours different kinds of theſe liquors, and many of them may be copiouſly impregnated with one ſort of mineral or other, they may have diſtinct periods for their reſpective coalitions, and yet ſtick cloſe to one another. For tho' in chymical cryſtallizations we uſually take out of the veſſel, what ſhoots the firſt time, before a freſh exhalation be made for a new cryſtallization, and by this means find the coagulated bodies obtain'd at one time, more uniformly ſhap'd than at another; yet in the hollow receptacles which the earth affords to petreſcent liquors, the veſſel continuing the ſame from firſt to laſt, the uniformity of the bodies produc'd by coalitions, made at ſeveral times, muſt be leſs regular, and the manifeſt accretions of coaleſcent bodies, in all likelyhood, be more frequent. And, accordingly, having long continued the exhalations of ſome liquors, in the ſame veſſel, I had coalitions of very different bodies at the bottom. I might add, that in ſome circumſtances, even in theſe veſſels, and therefore without any manifeſt exhalation of the water, or other menſtruum, and, ſometimes, where the diſſolved body was homogeneous, I have, in proceſs of time, had coagulations, where the cryſtals laſt formed ſeemed plainly to have been generated by way of accretion to the firſt.

Whence it is that ſtones of various kinds, petrified animals, &c. are found in dry places, ſolid rocks, &c.

I ſhall now endeavour to clear a grand difficulty, which I foreſee may be objected to our hypotheſis; namely, that theſe accretions, of medicinal or other ſtones, are, ſometimes, found in places where there are no petrifying ſprings, and, perhaps, no water at all; nay, little or nothing but quarries, or maſſes of ſtone.

To this I anſwer: firſt, that if we admit the relations of approved authors, concerning men and beaſts being ſuddenly turn'd into ſtone, by a petrifying ſpirit; it is not abſolutely neceſſary there ſhould be any petreſcent ſprings, or other water, to produce ſuch minerals as we are ſpeaking of.

(2.) For any thing that has hitherto appeared to the contrary, we may ſuppoſe that rain-water, ſometimes, brings along with it ſuch petrifying particles as may ſerve our turn. I am informed, by a judicious perſon, who viſited a famous bath in *Hungary*, the water whereof greatly abounds in petreſcent particles, that to the roof of a tall ſtructure which ſtands over it, there were faſten'd many long ſtony concretions, affirmed by him to be generated there from time to time, not by the daſhing up of any drops of water, which could not reach near ſo high; but by the copious petrific ſteams, that being there check'd in their aſcent, coagulated, according to their natural propenſity, into ſtone. Hence it ſeems not impoſſible, that ſtone ſhould, in ſome places, be generated without the help either of rain or ſprings, by the aſcent of petrific

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made perſons wonder how they came there; no water, or other liquor, appearing near them.

(4.) It may eaſily happen, that the petreſcent liquor ſhall be ſo mixed and diluted with ordinary water, as not to be diſtinguiſh'd from it, nor be capable of diſcloſing it ſelf by its effects; till either by a large exhalation of the common water, or by ſome peculiar advantages it has to operate upon bodies, it gains a proper opporrunity. There is a lake in the north of *Ireland*, wherein fiſh live, as well as in other lakes; tho' there are ſome rocks at the bottom of it, to which many maſſes, and pieces of a finely figur'd ſubſtance, tranſparent as cryſtal, faſten themſelves. Now if we ſuppoſe, that either by ſprings of petreſcent water, or by rains, or by ſubterraneal ſteams, or, otherwiſe, waters reſting in any hollow place, tho' upon the tops of rocks or mountains, ſhall be ſufficiently impregnated with petrific particles; and that afterwards, in proceſs of time, the merely aqueos parts ſhall gradually, by the heat of the ſun, the ſoaking of the ground, the winds, or the continual action of the air, be brought to exhale away in the form of vapours; the petrific particles, which are not ſo volatile, will turn the ſoil beneath them, and on the ſides of them, as far as the ſphere of their activity reaches, into ſtone, harder or ſofter, and into this or that kind, according to the particular nature of the petreſcent liquors, and the ſtructure, and other diſpoſitions of the ſoil they invade; in which ſoil, if there chance to be lodg'd bodies heterogeneous to it, whether vegetable ſubſtances, as roots, gums, *&c.* the whole bodies of animals, as toads, frogs, ſerpents, *&c.* or their parts, as ſhells, bones, *&c.* or minerals of an open texture, as boles, unripe ores, or elſe gems, or ſtones of another kind already form'd; any of theſe things, or any other that ſhall chance to be lodg'd there, muſt be found either petrified, or inclos'd in ſtone, when this harden'd ſoil ſhall come to be broke up. Nor is it at all neceſſary, that ſuch petrifaction of the extraneous bodies, and of the ſoil or bed, be made at once; for it may well happen ſucceſſively, at ſeveral times, according as ſome parts of the petreſcent juice are more copious and penetrating; and conſequently more fit to be ſoaked in, further than others. For as the poroſity happens to be greater in one part of the ſoil, than in another; or as the texture and diſpoſition of the particular bodies lodged in the earth, give advantage to the petrifying particles to work on ſome of them ſooner, or in a different manner than in others; ſo the induration of the pervaded ſubſtances may be very unequally made in point of time, as well as in other circumſtances. Whence it appears, how medicinal ſtones, of very different colours, conſiſtencies, and operations, may be gererated, and ſeem entire bodies, tho' one part of them be dark, heavy, and opake; and the other much lighter, tranſparent, and quite of another colour. And upon the ſame principle may be explained, the manner wherein diamonds are inclos'd

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in looſe ſtones, or even in rocks; of which we have credible teſtimony. Nor does this appear more ſtrange, than that a ſtone, which I have by me, a kind of pebble, ſhould contain a perfectly ſhap'd ſerpent, coiled up in it, without a head; which ſeems to have been form'd before the ſtone, becauſe in the upper and lower parts of that ſolid, there are cavities left, that together make up one entire cavity, juſt of the ſize and ſhape of the contained body; whereto, as it was eaſie for the matter of the ſtone, whilſt ſoft, to accommodate itſelf exactly; ſo 'tis ſcarce conceivable how, if the pebble had been firſt form'd, the inclos'd animal, if it were one, or the matter in that form, ſhould not only get in, but find a cavity ſo curiouſly ſhap'd, and fitted to its bulk. And that this variety was produced at ſeveral times, might be farther argued from hence, that the ſeeming ſerpent is plainly another and clearer kind of ſtone, than that of the mould which includes it; and of the mould it ſelf, one part contiguous to the included body is whitiſh, and abounds in ſhining grains, or flakes; in both which it differs from the other, which is far the greater part. NAT. HIST.

(5.) In thoſe very places, where now there is nothing to be ſeen but looſe ſtones, there may formerly have been petreſcent liquors, either ſtagnant or running; for earthquakes, inundations, ſinkings of the ground, incroachments of the land on the water, fiery eruptions, and ſuch accidents, may, among other odd effects, have dry'd or choak'd up pools and lakes, and quite ſtopp'd, or diverted the courſe, both of ſprings and rivers, ſo as to leave no remaining ſigns of them. Upon this account, and other great changes in the ſtructure and diſpoſition of the ſoil of ſeveral places, it may well be ſuſpected, that the ſtony moulds, wherein the above-mentioned bodies were found, might heretofore have been of an earthy nature, and the receptacles of petreſcent liquors, which, at ſeveral times, turn'd the whole maſs of the ſoil into ſtone, before the ſprings, or other waters, containing the petrific liquors, were quite conſumed, or had their courſe altogether diverted. And many things might be produced to ſtrengthen this conjecture.

The tinctures and ſolutions of ſtones abound in metalline or mineral particles.

3. It agrees very well with our doctrine about the great ſpecific gravity of theſe ſtones, in compariſon of white marble, or tranſparent pebbles, that it is poſſible out of them, to extract ſome of the ſubſtance ſuppos'd to give them that additional ponderoſity. And, accordingly, we have, by appropriated menſtrua, obtained from ſuch bodies, ſolutions or tinctures; which, not to inſiſt on their colour or taſt, wou'd, upon their being dropt into a tincture of galls, or other convenient liquor, produce ſuch phenomena, as argued them to abound with metalline or mineral particles; which, for the moſt part, I obſerved to be of a vitriolic nature. Thus I found, that the ſolution of a blood-ſtone, which taſted very rough upon the tongue, wou'd with the infuſion of galls, make an inky mixture; and the

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like happened with load-ſtone, emery, marcaſites, &c. open'd by corroſive menſtrua. But the ſolution of *Lapis Calaminaris*, which was of a golden colour, did not operate like the reſt on the infuſion of galls; yet by its taſt, as well as colour, ſufficiently ſhew'd it ſelf to have copiouſly impregnated the menſtruum. The mention of *Lapis Calaminaris*, reminds me of an inſtance of there being other ways, beſides that of diſſolution, in proper menſtrua, to ſhew that ſome medicinal ſtones participate of metalline and mineral ſubſtances; for it is by melting this ſtone with copper, and keeping them together for a competent time in fuſion, that braſs is made; wherein the red colour of the copper is changed into a golden one, and the abſolute weight conſiderably increaſed. Nor is this the only mineral ſtone from which I have, by a way quite different from thoſe hitherto mention'd, namely, with running mercury, obtained a metalline ſubſtance. And tho' native cinnabar be looked upon by the vulgar as a red ſtone, yet 'tis known, in the quick-ſilver mines, to be a mercurial ore; whence, by vehement fires, they diſtil running mercury, as we by a moderate one have ſometimes done.

Even the lighter ſtones may be mixed with metalline matter.

There are, however, ſome ſtones, that have uſeful qualities aſcribed to them, tho' they appear to be not at all, or ſo little heavier *in ſpecie*, than is requiſite for a mere ſtone, as to render it very unlikely, that metals, or ponderous minerals, ſhould contribute to their production or virtues.

But our hypotheſis does not oblige us to deny, that there may be ſuch ſtones; for tho' it aſcribes the virtues of moſt gems and ſtones to the metalline and ponderous mineral ſubſtances they partake of, yet the conceſſion agrees very well with our doctrine, which teaches, in general, that the virtues of ſtones may, in many caſes, depend upon their being impregnated with other minerals; which, tho' they moſt commonly prove ſpecifically heavier, than the mere petreſcent matter; yet in ſeveral ſtony concretions, the adventitious ingredients may be ſpecifically lighter than the genuine matter of the ſtone; as we have formerly ſeen in ſeveral bodies which paſs for ſtones. Thus not to repeat what has been ſaid of ſalts, I have obſerved that ſome other hard foſſils abound with a kind of bitumen, which, when, by diſtillation, brought to an oil, is much lighter than a ſtone of the ſame bulk; and I have had ſome portions of ſuch oil that wou'd ſwim even upon common water. And leſt this ſhould be aſcribed to the ſubtilization the bitumen received from the fire, I will add, that having hydroſtatically weighed a piece of good *Aſphaltum*, we found it to be to water of the ſame bulk, but as 1, and ſomewhat leſs than $1\frac{4}{10}$ to 1; which was within a tenth of the proportion of a ſtony bituminous foſſil to water, commonly call'd in *England*, *Scotch* coal. And becauſe ſulphur, as well as bitumen, is very apt, even by a moderate heat or attrition, to diffuſe its ſteams; let it be noted, that there are various hard ſtones which abound in ſulphur; and yet

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Since then there are mineral exhalations of very different kinds, diſpers'd in many places under ground; and ſince there are ſeveral volatile minerals, as arſenic, orpiment, ſandarac, *&c.* that are very actively hurtful, there may others be endowed with medicinal qualities; and the exhalations of ſuch minerals, either alone, or mix'd with petreſcent liquors pervading duly diſpoſed earths, boles, or other fluid, ſoft, open ſubſtances, before their induration, may impregnate them with medicinal and other qualities.

And even when more ſolid.

Nay, when I recollect the odd phenomena, that I have partly obſerv'd, and partly received from credible teſtimony, about the coalitions, mixtures, tinctures, and their effects, in metalline, ſtony, and other foſſil concretions, I dare not peremptorily deny, that, even after ſubterraneal bodies have obtain'd a conſiderable degree of induration, and, perhaps, enough to make them paſs for ſtones, there may be ſubterraneal ſteams able to penetrate, tinge, and otherwiſe impregnate them; which ſeems the leſs incredible from what was juſt now related out of *Kentman*, and eſpecially from my own experiments, made to tinge native cryſtal with different colours, by the fumes of volatile minerals. And that a very ſmall proportion of a metalline ſubſtance, reſolv'd into minute particles, may impart a tincture to a great quantity of other matter, duly diſpoſed, appears from thoſe factitious gems, wherein, with three or four grains of a metal, ſkilfully calcined, or ſome mineral pigment, we can give the colour of a natural gem to a whole ounce or more, of a vitrified material. In more ſubtile fluids I have made the inſtance, vaſtly more conſpicuous, by tinging with one grain or leſs of a prepared metal, as gold or copper, as much phlegm, ſucceſſively generated, as would, if it could have been all preſerv'd, have amounted to a bulky quantity of deeply-colour'd matter.

Some ingredients of opake gems, and medicinal ſtones, may, before they received this form, have been complete minerals.

4. The laſt thing I ſhall produce to ſhew, that the virtues of opake gems and medicinal ſtones may be more eaſily, than thoſe of tranſparent ones, accounted for on our hypotheſis is, that the principal ingredients, whereof many ſuch opake ſtones conſiſt, were complete mine-

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ral bodies before they were petrified; ſome of them having been medicinal boles, or the like earths; ſome earths abounding with metalline or mineral juices; ſome ores of metals or minerals of kin to metals; and ſome, in fine, bodies of other natures, differing from theſe and from one another. For all ſuch ſeveral kinds of foſſils may, by the ſupervention and pervaſion of petrific ſpirits, be turned into ſtone; and conſequently, retain many of the virtues they were endowed with by the mineral corpuſcles that had copiouſly impregnated them, whilſt they remained bodies of a more open or penetrable texture. NAT. HIST.

I might illuſtrate this from the methods whereby I made ſuch mixtures of ſtony and metalline ingredients, as notwithſtanding their coalition, were tranſparent; tho' that be more difficult than to compound ſuch concretions when they are deſigned to be opake. But here, again, I muſt obviate an objection, that may be made to the preſent argument. For ſince it ſeems, by our doctrine, that gems may be only magiſteries, and conſequently but ſuch compoſitions as, tho' made in the bowels of the earth, might be imitated by human ſkill; it may appear very improbable to many, that bodies, ſo near of kin to artificial ones, ſhould poſſeſs ſuch peculiar and ſtrange virtues as are aſcribed to ſeveral gems, and thought capable of flowing only from certain very noble ſubſtantial forms.

To this I might reply, that I admit not any ſuch imaginary beings, as the peripatetic forms, which, I believe, will never be demonſtrated to exiſt. But to avoid unneceſſary diſputes, I rather anſwer, in ſhort, that ſuch compoſitions as are called artificial, may, nevertheleſs, be endowed with great virtues, and ſuch as are called ſpecific; witneſs the virtues of many chymical preparations, even of thoſe that are uſed by phyſicians of all ſorts; nay, even *Galen* himſelf will furniſh us with inſtances to our preſent purpoſe. For to the aſhes of crawfiſh, which, notwithſtanding the deſtruction that has been made of their priſtine body by fire, he gives a greater commendation againſt the bite of a mad dog, than to the fiſh it ſelf unburn'd, or to any medicines of nature's providing: and a virtue of that kind and degree will ſurely be allowed ſpecific. And the *Theriaca*, tho' a factitious body, and conſiſting of a multitude of ingredients huddled together, was yet, in the days of *Galen*, eſteemed a moſt famous antidote; and has ſince been celebrated, not only for its alexipharmic virtues, which alone are ſufficient to entitle it to a ſpecific; but for many others, either upon account of its manifeſt or occult qualities.

Whence ſtones of the ſame kind have different qualifications.

But farther, according to our way of explaining the production of medicinal ſtones, a probable ſolution may be given of this difficult phenomenon, that, ſometimes, ſtones allow'd, without ſcruple to be of the ſame kind, are of ſuch different qualifications, that ſome of them prove very conſiderable remedies in caſes where others are almoſt ineffectual. And I have, ſometimes, obſerved, that a medicinal ſtone may have virtues, ſuppoſed to be the properties of ſtones of another kind.

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kind. For, according to our hypotheſis, when the ſtony matter is impregnated as it ought to be, with thoſe minerals that in the ordinary courſe of nature belong to its ſpecies, its virtue will be ſuch as it ſhould be for kind; but for degree may be very various, according to the quantity, purity, ſubtilty, *&c.* of the mineral that impregnates it. But if the ſtony matter chance to be imbued with ſome other ſubſtance of a contrary nature, tho' perhaps the proportion of it may be ſo ſmall, and the colour of it ſuch as not to render an alteration in the ſtone, obvious to ſenſe, and conſiderable enough to make it judg'd of another ſpecies; yet it may ſo vitiate the matter, wherein its quality reſides, or check and infringe its operation, as not to leave the ſtone any great degree of virtue. On the other ſide, if it happen that the mineral corpuſcles, which uſually impart a certain virtue to the ſtony matter of one gem, ſhould, by ſome lucky hit, be ſo united with that of another ſort, (of which I formerly gave an inſtance in green diamonds,) tho' the quantity of this unuſual ingredient may be but very ſmall; yet if its efficacy be great, it may ennoble the ſtone with a remarkable degree of ſome ſuch virtue, as is ſuppoſed not to belong to that ſpecies, but to another. Thus I have been told of ſurprizing virtues in a ſtone for the ſtanching of hemorrhages; tho' by its colour and texture I ſhould never have taken it for a blood-ſtone.

The ſubtilty and penetrating virtues of ſome liquors, if duly conſider'd, may ſhew it to be poſſible, that ſuch bodies ſhould be petrified by them, as in part conſiſt of animal and vegetable ſubſtances. Thus we ſee petrified ſhells, bones, and pieces of wood; and that ſoft ſtone, which is plentifully found near *Naples*, and commonly called *Lapis Lynceurius*, being rubb'd a little, moiſten'd with water, and then expoſed to the ſun, in a due ſeaſon of the year, will, in a very ſhort time, as eye-witneſſes have aſſured me, produce muſhrooms fit to be eaten; as if even the ſeminal principles and rudiments of vegetables may be ſo preſerv'd in a petrified earth, as to diſcloſe themſelves when they find an opportunity. And an eminent perſon, maſter of ſome of theſe ſtones, informs me, that they now and then find them of a vaſt bigneſs; as if whole maſſes of earth, pregnant with the prolific principles of muſhrooms, were, by ſome ſupervening petreſcent liquor, turned into ſtone.

Various earths may be petrified, and contain ſurprizing, ſubtile, and medicinal parts.

And not only boles, ſeal'd earths, and ſuch like foſſils, as are commonly known for medicinal, may be harden'd into ſtone by petrifying agents; but other earths, ſubject to petrifaction, may contain medicinal and ſubtile particles, of ſuch a kind as ſeems ſcarce credible. I have ſeen a clay-pit, wherein, at a conſiderable depth from the ſurface of the earth, there lay a bed of clay, which, by diſtillation, yielded a ſalt ſo volatile and ſtrong, and ſo different from other ſubterraneal ſalts, that I could not obſerve the manifeſt qualities of it without wonder; and the owners of the pit, who were rich and curious perſons, did themſelves

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

OBSERVATIONS
UPON
DIAMONDS;
And particularly upon one which wou'd ſhine, remarkably, in the dark.

Promiſcuous obſervations upon diamonds.

DIamonds being generally eſteemed the moſt noble and precious of inanimate bodies, I cou'd nòt but gratifie my curioſity about them, by propoſing queſtions, whilſt a director of the *Engliſh Eaſt-India* company, to ſome *Eaſt-India* merchants and jewellers, who had dealt much with theſe gems.

And diamonds deſerve the rather to be enquired into, becauſe the commerce they help to maintain between the weſtern and eaſtern parts of the world, is very conſiderable. For as ſmall as their bulk is, their properties and mens opinion, ſo greatly recommend them, that, I remember, one of the moſt famous and intelligent merchants of this nation, aſſured me, that, according to his well-grounded eſtimate, there came of them from the *Eaſt-Indies* into *Europe*, one year with another, to the value of 350,000 *l. Sterl.* whereof about 100,000 *l.* came into *England*; which at preſent, by the prudent indulgence of the government, and of the *Eaſt-India* company, is become the mart of diamonds.

To prove the great hardneſs of diamonds, even in compariſon of other bodies, that are thought wonderfully hard, a famous artiſt for cutting of theſe ſtones affirm'd to me, that he could neither cut or poliſh diamonds with any thing but diamonds; and that if he ſhou'd employ ſo rough a way, and ſuch forcible engines to cut rubies, or any other ſtones, as he does to cut thoſe, it wou'd preſently break them in pieces; which, by the inſpection of his engine, appear'd very probable.

A very ſkilful cutter and poliſher of diamonds, told me, that having dealt in them near twenty years at *Amſterdam*, and ſeveral years in *England*, he perceived there are of late brought over worſe ſorts of diamonds; ſo that he judges thoſe of the old rock (as he calls them) either to be quite ſpent in the *Indies*, or, at leaſt, to be ſeldom or never tranſported. And he finds ſeveral late diamonds, ſo ſoft and brittle, in compariſon of thoſe of the old rock, that he is often afraid, or unwilling to meddle with them, leſt he ſhould ſpoil them in the cutting or poliſhing. NAT. HIST.

Notwithſtanding the wonderful hardneſs of diamonds, there is no truth in the tradition, that repreſents them unable to be broken by any external force, unleſs firſt ſoften'd by being ſteep'd in the blood of a goat. This odd aſſertion, I find to be contradicted by the frequent practice of diamond-cutters: and particularly, having enquired of one of them, to whom abundance of thoſe gems are brought, to be fitted for the jeweller and goldſmith, he aſſured me, that he makes much of his powder to poliſh diamonds with, only by beating board-diamonds (as they call them) in a ſteel or iron mortar; and that he has by this way made, with eaſe, ſome hundred carrats of diamond-duſt.

'Tis a received opinion among many who deal in gems, that as diamonds are the hardeſt of bodies, ſo the ſame compactneſs, and their great ſolidity, gives them alſo proportionable gravity, and makes them extremely weighty with regard to their bulk.

But a rough diamond ſomewhat dark within, that in a pair of ſcales which turn'd with the 32^{d} part of a grain, weighed 8 grains, and $\frac{8}{16}$; being carefully weigh'd in water, according to the rules of hydroſtatics; it proved to an equal bulk of that liquor, as $2\frac{22}{23}$ to 1. So that, as far as can be judg'd by this trial, even a diamond weighs not thrice as much as water.

Aſking a famous and experienced cutter of diamonds, whether he did not find ſome rough diamonds heavier than others of the ſame bigneſs? he told me, he did, eſpecially if ſome of them were cloudy or foul; and ſhewing me a diamond that ſeemed to be about the bigneſs of two ordinary peaſe, or leſs, he affirm'd, that he ſometimes found in diamonds of that ſize, compared together, about a carrat (or four grains) difference in point of weight.

The ſhape or figure of diamonds is not eaſie to be ſecurely determin'd. For thoſe that are ſeen in rings and other jewels, having been, by way of preparation cut and poliſh'd, change their natural figures for that which the artificer thinks fit to give them. And rough diamonds themſelves (which are not eaſily met with) often come to our hands broken, tho' undeſignedly, by the diggers; and are, therefore unfit to acquaint us with their genuine ſhape; which we may be unable to diſcover, becauſe of the accidents whereto the matter they conſiſted of was ſubject in the mine. For having had a parcel of

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Diamonds have a grain, or a determinate tendency of their fibres, or rather of the thin plates they are made up of, as well as wood; and may, with ease, be split along the grain, tho' not against it. I have seen a very large diamond, that was cut, with the grain, into three pieces, whereof the middlemost, tho' large, and about the thickness of a shilling, was evenly thick, and exactly flat on both sides; and I possess a diamond-ring, whose stone I caus'd to be set rough, as nature produced it, because in that state the grain is manifest to the naked eye; (and much more when viewed thro' a glass, that moderately magnifies the several plates it consists of) having their edges distinguishable like those of a book a little open'd. An experienced cutter of these gems assured me, that one large blow may split even great diamonds, if it be given, as they speak, with the grain, but against the grain, he affirm'd to me, he is not able so much as to cut or polish them.

The common colour of diamonds being generally known by sight, 'tis not necessary, nor wou'd it be easie to describe it by words; but the most usual colour of these gems is not the only one. A great traveller into the eastern parts of the world, assured me, that he had seen some of them that were of a pale bluish colour. That famous *French* jeweller, Monsieur *Tavernier*, gives an account of a fair diamond that he had, of a very red colour; a great lady told me, she was mistress of a fair one, which, tho' not of a ruby, was of a red colour: and a relation of mine used to wear a diamond-ring; which, tho' the stone was not great, he valued at a hundred pounds, because its colour was of so fine a golden yellow, that I should have taken it for an excellent topaz. And attentively surveying a parcel of rough diamonds, newly brought from the *East-Indies*, I perceived among them, besides several lighter variations of colour, one stone, which was all green; and this to such a degree, that I doubted not, if polished and set, it might pass for an excellent emerald. I should

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Boetius de Boot, indeed, who is judg'd the beſt author upon the ſubject of gems, allows no ſuch virtue in diamonds, and peremptorily ſays, "no man ever durſt aver he had actually ſeen a ſtone that, of "it ſelf, afforded light. *Johannes de Laet*, alſo, thinks no inſtance of "it can be produced." And *Olaus Wormius* ſeems to imagine it falſely reported even of the carbuncle. And, indeed, upon examining a moſt excellent ruby, I could not, by friction, bring it to afford the leaſt glimmering of light.

Whether gems are, of themſelves, luminous.

But tho' I am loth to admit ſtrange things for truth, yet I am not very forward to reject them as impoſſibilities; and therefore, would not diſcourage any from making farther inquiry, whether there be ſuch a thing as a true carbuncle, or ſtone, that, without rubbing, will ſhine in the dark? For if ſuch a thing can be found, it may afford no ſmall aſſiſtance in diſcovering the nature of light. *Vartomannus*, indeed, was not an eye-witneſs of what he relates, that the king of *Pegu* had a true carbuncle, of that bigneſs and ſplendor, as to ſhine very gloriouſly in the dark; and tho' *Garcias ab Horto*, the *Indian* vice-roy's phyſician, ſpeaks of another carbuncle only upon the report of one he diſcours'd with, who affirmed himſelf to have ſeen it; yet as we are not ſure that theſe pretended eye-witneſſes ſpeak true, they may have done ſo, for ought we know to the contrary. And I could produce a much more conſiderable teſtimony to the ſame purpoſe, if I had the permiſſion of the perſon. But I may ſay, that *Marcus Paulus Venetus*, whoſe ſuppoſed fables many of our later travellers and navigators have ſince found to be truths, ſpeaking of the king of *Zeilan*, tells us, he is ſaid to have the beſt ruby in the world, a palm long, and big as a man's arm, without ſpot, and ſhining like a fire. He adds, that the great *Cham* offer'd the value of a city for it; but the king anſwer'd he would not exchange it for the treaſure of the world; becauſe it had deſcended to him from his anceſtors. And two *Ruſſian Coſſacks* relate, in the account of their journey to *Catray*, dedicated to their emperor, that they were told, the king of thoſe parts had a ſtone which gives light like the ſun, both day and night, and call'd, in their language, *Sarra*; which thoſe *Coſſacks* interpret a ruby. But theſe relations are too uncertain to build any thing upon. However, there arriv'd here about two years ſince, out of *America*, the governour of one of the principal colonies there, an ancient virtuoſo, and a member of the Royal Society, who, finding the chief affairs of his country committed to me and another, made me ſeveral viſits, and in one of them told me, the *Indians* had a tradition, that in a certain, almoſt inacceſſible hill, far up in the country, there was a ſtone, which, in the night time, ſhone very vividly to a great diſtance; and he aſſured me, that tho' he thought it not fit to venture him-

himſelf ſo far among thoſe ſavages, yet he purpoſely ſent a bold *Engliſhman* thither, with ſome natives for his guides; and that this meſſenger brought him back word, that at a diſtance from the hill he had plainly perceived ſuch a ſhining ſubſtance as the tradition implies; and ſlighting the ſuperſtitious fears of the inhabitants, with great difficulty, made a ſhift to clamber up to that part of the hill where, by a very careful obſervation, he ſuppos'd himſelf to have ſeen the light; but whether he had miſtaken the place, or for ſome other reaſon, he cou'd not find it there; tho' when he was return'd to his former ſtation, he again perceived the light in the ſame place where it ſhone before. I reſerve to my ſelf a full liberty of believing no more of this relation than I ſee cauſe; yet I the leſs ſcruple to communicate it, becauſe it agrees, in great meaſure, with the following accounts. For tho' the learned authors, I formerly mentioned, think no writer has affirmed himſelf to have ſeen a real carbuncle; yet conſidering the light of Mr. *Clayton*'s diamond, it recall'd to my mind, that ſome years before I had met with an old *Italian* book, highly extoll'd by very competent judges, the author whereof is *Benvenuto Cellini*, who has a paſſage in it to this purpoſe. "In *Clement* the 7th's time, ſays he, I happen'd to ſee a carbuncle at a certain *Raguſian* merchant's, named *Beigoio di Bona*. This was a white carbuncle of that vivid kind of paleneſs we ſee in a chalcedonian; but it had a ſurprizingly pleaſant luſtre, and ſhone in the dark, tho' not ſo much as colour'd carbuncles; however, in an exceeding dark place, I ſaw it ſhine in the manner of fire almoſt extinguiſhed. But as for colour'd carbuncles, it has not been my fortune to ſee any. But a *Roman* gentleman of great experience in jewels told me, that one *Jacopo Cola* being, by night, in a vineyard of his, and ſpying ſomething in the midſt of it that ſhone like a little glowing coal, at the foot of a vine, he went near the place where he thought he had ſeen the fire; but not finding it, he ſaid, that being returned to the ſame place whence he had firſt ſeen it, and perceiving there the ſame ſplendor as before, he mark'd it ſo carefully, that at length he came to it, and took up a very little ſtone, which he carried away with tranſport. And the next day relating to ſome friends after what manner he had found it, a *Venetian* ambaſſador, very ſkilful in gems, happening to be preſent, knew it to be a carbuncle, and therefore ſubtilly, before he and the ſaid *Jacopo* parted, purchas'd it for ten crowns, and immediately left *Rome*, to avoid reſtoring it. He farther affirms, that this *Venetian* gentleman afterwards ſold it to the grand Seignior for a hundred thouſand crowns."

Here *Cellini* affirms himſelf to have ſeen a real carbuncle with his own eyes; and he appears to be very cautious in what he delivers, and is inclin'd rather to leſſen, than increaſe the wonder of it. This teſtimony is the more conſiderable, becauſe tho' *Cellini* was born a ſubject neither to the pope nor to the king of *France*, yet both thoſe princes employed him much about their nobleſt jewels. What is now reported

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ed concerning a ſhining ſubſtance to be ſeen in one of the iſlands about *Scotland*, I leave to Sir *Robert Morray*, to whom the information was originally given. M. *Boreel*, an ingenious *Dutch* gentleman, whoſe father was long ambaſſador for the *Netherlands* in *England*, told me, he was acquainted with the admiral of the *Dutch* in the *Eaſt-Indies*, who aſſured him, that at his return from thence, he brought with him into *Holland* a ſtone, which, tho' it look'd but like a pale, dull diamond, ſuch as Mr. *Clayton*'s was, yet proved a real carbuncle, and did, without rubbing, ſhine ſo much, that when the admiral had occaſion to open a cheſt, which he kept under deck, in a dark place, it would immediately, by its native light, illuminate a great part thereof. I impatiently expect a more particular account of this ſtone from the admiral himſelf, who is ſtill alive in *Holland*; not only becauſe ſo unlikely a thing needs a clear evidence, but becauſe I have had ſome ſuſpicion that, ſuppoſing the truth of the thing, what may be a ſhining ſtone in a very hot country, as the *Eaſt-Indies*, may, perhaps, ceaſe to be ſo in one as cold as *Holland*. For in Mr. *Clayton*'s diamond, I obſerved, that a very moderate degree of warmth, without friction, would make it ſhine a little. And, I confeſs, this is not the only odd ſuſpicion my experiments upon that diamond have ſuggeſted to me. Nay, I begin to doubt whether it may not, in ſome caſes, be true, that the right turquoiſe will change colour as the wearer is ſick or well; and manifeſtly loſe its ſplendor at his death. For when I found, that even the warmth of a friction, that laſted not above a quarter of a minute, and even that of my body, whoſe conſtitution is none of the hotteſt, would make a manifeſt change in a diamond; it ſeem'd not impoſſible, that certain warm and ſaline exhalations, iſſuing from the body of a living man, may, ſome way or other, by their preſence or abſence, diverſify the colour and the ſplendor of ſo ſoft a ſtone as the turquoiſe *. 'Tis ſo very remarkable what the judicious lapidary, *Boetius de Boot* affirms of this ſtone, that the narrative of it ought not to be omitted. "I conſtantly wear a turquoiſe in a ring, ſays he, the "ſtrange property whereof I can never ſufficiently admire. Thirty "years ago 'twas worn by a *Spaniard*, and, after his death, expoſed to "ſale among the reſt of his goods; upon the report whereof, there "was a great concourſe of ſuch perſons as had formerly admired its "beauty, and among the reſt my father: but they were all ſurpriz'd "to find it quite ſully'd and faded; whence they conjectur'd it had "been chang'd for another: my father, however, bought it for a "very ſmall matter, but thought ſo meanly of it, that ſince, cry'd "he, 'tis a common ſaying, that a turquoiſe muſt be made a preſent "of before it will diſplay its virtue, do you, my ſon, wear it; but

Whether the turquoiſe ſtone may loſe its luſtre upon the ſickneſs or death of the perſon who wears it.

* Turquoiſe ſtones are nothing but animal bones petrified, and a blue colour given them by fire. There are mines of them in *France*: and a large account is given of this matter in the *French* memoirs. *A.* 1715. *p.* 230.

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DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

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Obſervations upon a diamond that would ſhine, remarkably, in the dark.

1. This was a table diamond, about a third of an inch in length, and ſomewhat leſs in breadth; a dull ſtone, of a very bad water; having in the day time very little of the vividneſs of ordinary diamonds, and being blemiſhed with a whitiſh cloud about the middle, which covered near a third of the ſtone. 2. Nothing remarkable appeared in any part of it, when examined with a microſcope; but view'd in the day time, in a bed, with the curtains carefully drawn, I could not diſcern it to ſhine at all, tho' well rubb'd; but about a little after ſun-ſet, whilſt the twilight yet laſted; and in the morning, a pretty while after ſun-riſing, I could, after a light friction, eaſily perceive it to ſhine. 3. The candles being remov'd, I could not, in a dark place, diſcern the ſtone to have any light when I looked on it, without having rubb'd, or otherwiſe prepared it. 4. Neither by two white pebbles, hard rubb'd one againſt the other, by the long and vehement friction of rock cryſtal, againſt a piece of red cloth; nor by rubbing two diamonds ſet in rings, as I had rubb'd this ſtone, could I produce any ſenſible degree of light. 5. I found this diamond hard enough not only to write readily upon glaſs, but to grave on rock-cryſtal it ſelf. 6. I found this to have, like other diamonds, an electrical virtue; for it wou'd attract light bodies, as amber, jet, *&c.* tho' in a leſs degree. 7. Being rubb'd upon my cloaths, as is uſual, to excite amber, wax, and other electrical bodies; it did, in the dark, manifeſtly ſhine like rotten wood, the ſcales of whitings, or other putrified fiſh. 8. But this light was fainter than that of the ſcales and ſlime of whitings, and much fainter than the light of a glow-worm; by which I have ſometimes been able to read a ſhort word; but after an ordinary friction of this diamond, I cou'd not diſtinctly diſcern any of the neareſt bodies by the light of it. This glimmering, alſo, very conſiderably decay'd, immediately upon ceaſing the friction; tho' the ſtone continued viſible for ſome time after. 9. But if it were briſkly rubb'd upon a convenient body for a pretty while, I found the light would be, for ſome moments, much more conſiderable, almoſt like the light of a glow-worm; ſo that, after I had ceas'd rubbing, I cou'd, with the chafed ſtone, exhibit a little luminous circle, faintly reſembling that made by the motion of a ſtick fired at one end; and thus it wou'd continue viſible, about ſeven or eight times as long as the preceding friction laſted. 10. I found, that holding it a while near the flame of a candle, with my eyes turn'd a contrary way, and immediately removing it into the dark, it diſclos'd ſome faint glimmering, but inferior to that acquired by rubbing. And afterwards holding it near a fire, that had but little flame, it was rather leſs excited thereby, than by a candle. 11. I, likewiſe, endeavoured to make it ſhine, by holding it for a pretty while in a very dark place, over a thick piece of iron, that was well heated, but not to that degree as to be viſible. And tho' at length I found the ſtone hence acquired ſome glimmering, yet it was leſs than it

gain'd

gain'd by either of the other ways juſt mentioned. 12. I alſo brought it to ſome glimmering kind of light, by taking it into bed, and holding it a good while upon a warm part of my naked body. 13. To ſatisfy my ſelf, whether the motion introduced into the ſtone, generated the light upon account of its producing heat there; I held it near the flame of a candle, till it was qualified to ſhine pretty well in the dark; and then immediately apply'd a ſlender hair, to try whether it would attract it; but found not that it did. And for further confirmation, I once purpoſely kept it ſo near the hot iron, lately mentioned, as to make it ſenſibly warm; yet it ſhone more dimly than it had done by means of friction, or the flame of a candle; tho' by both thoſe ways it acquired not any ſenſible warmth. 14. Having purpoſely rubb'd it upon ſeveral bodies, different both in colour and in texture, there ſeemed to be ſome little difference in the excitation of the light. Upon white and red cloth it ſeemed to ſucceed beſt, eſpecially in compariſon of black. 15. But to try what it would do when rubb'd upon bodies more hard, and leſs apt to afford heat upon a light friction, than cloth, I firſt chafed it upon a white wooden box, by which it was excited; and afterwards upon a piece of earth purely glaz'd; which ſeem'd, during the attrition, to make it ſhine better than any of the other bodies, without excepting the white ones; ſo that the effect cannot be aſcribed to the greater diſpoſition white bodies have to reflect light. 16. Having well excited the ſtone, I ſuddenly plung'd it under water, provided for that purpoſe; and perceived it to ſhine whilſt it was beneath the ſurface of the liquor; and this I did ſeveral times. But when I endeavoured to produce a light, by rubbing it upon the box lately mentioned, while both the ſtone and it were held beneath the ſurface of the water, I did not well ſatisfie my ſelf in the event of the trial: but this I found, that if I took the ſtone out, and rubb'd it upon a piece of cloth, it would, as uſual, preſently yield a light; tho' it required to be rubb'd much longer, before the deſired effect was produced. We likewiſe plunged it, after we had excited it, in liquors of ſeveral ſorts, as ſpirit of wine, oil, both chymical and expreſs'd, an acid ſpirit, and an alkaline ſolution; but found not any of thoſe various liquors to deſtroy its ſhining property. 17. I alſo ſeveral times try'd, that by covering it with ſpittle, it did not loſe its light. And having found by this obſervation, that a warm liquor would not extinguiſh light in the diamond, I thought fit to try, whether, by reaſon of its warmth, it would not excite it; and found, that if it were kept in warm water, till that had communicated its heat thereto, it would frequently ſhine as ſoon as taken out; and, probably, we ſhould have ſeen it ſhine more, whilſt it remained in the water, if ſome degree of opacity, which heated water acquires, upon account of the numerous little bubbles generated in it, had not kept us from diſcerning

NAT. HIST.

NAT. HIST. the luſtre of the ſtone. 18. Finding that by rubbing the ſtone with the flat ſide downwards, I loſt, by reaſon of the opacity of the ring, and the ſudden decay of light, upon the ceſſation of the attrition, the ſight of the ſtones greateſt vividneſs; and ſuppoſing that the commotion made in one part of the ſtone, would be eaſily propagated all over, I ſometimes held the piece of cloth, upon which I rubb'd it, ſo, that one ſide of the ſtone was expos'd to my eye, whilſt I chaſed the other; whereby it appeared more vivid than formerly, and to make luminous tracts by its motions backward and forward. And, ſometimes, holding the ſtone upwards, I rubb'd its broad ſide with a fine ſmooth piece of tranſparent horn; by which means the light thro' that diaphanous ſubſtance appeared ſo briſk, whilſt I was actually rubbing the ſtone, that ſometimes, in ſome places, it ſeem'd to give little ſparks of fire. 19. I took alſo a piece of flat, blue glaſs, and having rubb'd the diamond well upon a cloth, and ſuddenly covered it with that glaſs, to try whether, in caſe the light could penetrate thro', it wou'd, by appearing green, or of ſome other colour than blue, aſſiſt me to gueſs, whether it were ſimple or no. But finding the glaſs impervious to ſo faint a light, I thought fit to try, whether hard bodies would not, by attrition, aſſiſt the diamond's light, ſo as to become penetrable thereby. And, accordingly, when I rubb'd the glaſs briſkly upon the ſtone, I found the light to be conſpicuous, and ſomewhat dyed in its paſſage; but could not eaſily give a name to the colour it exhibited. 20. Laſtly, ſuſpecting, upon the whole, that the principal, manifeſt change wrought in the ſtone, was by a compreſſure of its parts, rather than a heat; I found, that if I preſs'd the ſtone hard againſt a piece of white, well-glaz'd tile, it ſeemed, tho' I did not rub it, to ſhine at the ſides; but it ſhone very manifeſtly and vigorouſly, if, whilſt I thus preſs'd, I moved it any way upon the ſurface of the tile; tho' it drew not a line above a quarter of an inch long thereon; and tho' I only made it move from one end of that ſhort line to the other, without any return, or lateral motion: nay, after it had been often rubb'd, and ſuffered to loſe its light again, it not only ſeemed more eaſie to be excited than at firſt; but if I preſs'd hard upon it with my finger, at the very inſtant that I drew it briſkly off the ſtone, it would give a very vivid, but exceeding ſhort-liv'd ſplendor or little coruſcation. And preſſing the point of a ſteel bodkin, hard againſt the ſurface of the diamond, but much more if I ſtruck the point againſt it, the coruſcation would be extremely ſudden, and very vivid, tho' very vaniſhing too; and this way, which commonly greatly ſurprized and delighted the ſpectators, ſeemed far more proper than the other, to ſhew that preſſure alone, if forcible enough, tho' it were ſo ſudden and ſhort, that it could not well be ſuppos'd to give the ſtone any thing near ſo ſenſible a

degree

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NAT. HIST.

The light of rotten wood extinguiſhed in vacuo.

1. *Octob.* 29. 1667. Having procured a piece of ſhining wood, about the bigneſs of a groat or leſs, that gave a vivid light; we put it into a middle-ſized receiver, ſo that it was kept from touching the cement; and the pump being ſet a-work, we obſerved not, during the firſt five or ſix exſuctions of the air, that the ſplendor of the included wood was manifeſtly leſſened; though it was never at all increaſed; but about the ſeventh ſuck, it ſeem'd to grow a little more dim, and afterwards anſwered our expectation by loſing of its light more and more, as the air was pumped out; till about the tenth exſuction (tho' by the removal of the candles out of the room, and by black cloaths, *&c.* we made the place as dark as poſſible) we could not perceive any light at all proceed from the wood.

2. Wherefore we let in the outward air, by degrees, and had the pleaſure to ſee the ſeemingly extinguiſh'd light revive ſo faſt and perfectly, that it looked almoſt like a little flaſh of lightning, and the ſplendor of the wood ſeemed rather greater, than before it was put into the receiver.

But for greater certainty, and to enjoy ſo delightful a ſpectacle, we repeated the experiment with the like ſucceſs as at firſt. Wherefore being deſirous to ſee how ſoon theſe changes might be produced, we included the wood into a very ſmall receiver of clear glaſs, and found, that in this the light would begin to grow faint at the ſecond, or at leaſt at the third exſuction of the air, and at the 6th or 7th quite diſappear. And we found, by a minute-watch, that the ſending the candles out of the room, the pumping out the air till the wood would ſhine no more, the re-admitting of the air (upon which it would in a trice recover its light) and the ſending in for the candles to conſult the watch, did in all take up but ſix minutes.

3. Having exhauſted this new receiver, till the wood quite diſappeared, we ſtayed ſomewhat above a quarter of an hour in the dark, without perceiving that it had regained any thing of light; though about the end of this time, we made the place about it as dark as we could; and then (it being too late at night to protract the experiment,) we let in the air, upon whoſe admiſſion the wood preſently

" diamond on the other ſide; the light to " the eye of him who holds it, ſeems much " more pleaſant and perfect than in any other " way I have yet tried. But what is ſtill " more ſtrange, a diamond being expoſed " in the open air to the ſky, gives almoſt " the ſame light without rubbing, as if " rubbed in a dark room; and if in the " open air you any way hinder its com- " munication with the ſky, it yields no " light. I have tried all or moſt of the " other precious ſtones, but could find no " ſuch phenomenon in any of them My " experiments were made at the latter end " of *May*, and the beginning of *June*; ſo " that I pretend not to account for the phe- " nomena of experiments made when the " ſun is on the other ſide of the equator. " —— I am well aſſured, that all, or moſt " of the bodies which have an electricity, " yield light by friction." See *Philoſoph. Tranſact.* N° 314.

recovered

recovered light enough to be conſpicuous at a diſtance, tho' it ſeemed to me ſomewhat leſs vivid than before; which yet may be owing either to a weakneſs in my ſight, or an effect of the ſteams of the cement, unfriendly, perhaps, to the luminouſneſs of the wood. NAT. HIST.

The night following we put in a piece of wood bigger than the former, being above an inch long, and this ſhone very vigorouſly; and having by a few ſucks quite deprived it of light, we left it in the exhauſted receiver for full half an hour; and then coming into the dark room again, we found all had not continued ſo ſtanch, but that ſome air had inſinuated it ſelf into the receiver. This we concluded to be but a ſmall portion of air, becauſe the wood was barely viſible to an attentive eye: and yet, that it was really ſome air got in, that cauſed the little glimmering light we perceived, may appear by this, that it preſently vaniſh'd at the firſt or ſecond ſuck; and then the air being let into the dark receiver, the included wood preſently ſhone again, as before; tho' I ſuſpected that I diſcerned ſome little diminution of its brightneſs; which yet, till further trials of the like kind, and for a longer time, have been made, I dare not affirm.

4. Having obſerved, on another occaſion, that ſometimes the operation, which the withdrawing of the air hath upon a body included in the receiver, proves more conſiderable ſome minutes after we ceaſed pumping, than immediately upon leaving off that exerciſe; I imagined, that even in ſuch caſes, where the light is not made wholly to diſappear by the emptying of the pneumatical glaſs, the ſuffering the body to remain a while there, tho' without any pumping (unleſs now and then a very little to remove the air, that might have inſinuated in the mean time) the remaining light of the body might, probably, be further impaired, if not reduced quite to vaniſh. To examine this conjecture, we put in a body that was not wood, which had ſome parts much more luminous than the reſt; and having drawn out the air, all the others diſappeared, and even the formerly brighter ones ſhone but faintly, when the pneumatical glaſs, ſeemed to be exhauſted. But keeping the included body a while in that unfriendly place, we perceived the parts that had retained light, to grow more and more dim, ſome of them diſappearing, and that which was formerly the moſt conſpicuous, being now but juſt viſible to an attentive eye, and that ſcarce without diſpute; for if we had not known beforehand, that a ſhining matter had been included in the receiver, perhaps we ſhould not have found it out. And he who had the youngeſt eyes in the company, could not at all diſcern it; but the air being let in, the body began to ſhine again.

5. The rarifaction, or expanſion of the air, having ſo notable an operation upon our ſhining wood, I thought it would not be amiſs to try, what the compreſſion of the air would do to it: for which purpoſe we included a piece of it in ſuch a little inſtrument, or con-

NAT. HIST. condenſor, as was deviſed and propoſed by Mr. *Hook*. But tho' we impell'd the air forcibly into the glaſs, yet by reaſon of the thickneſs requiſite in ſuch glaſſes, and the opacity thence ariſing, we were not able to determine, whether any change was made in the luminouſneſs of the wood. Which I thought the leſs ſtrange, becauſe, by ſome experiments purpoſely deviſed, I had long ſince obſerved, that even a great preſſure from a fluid body, which preſſeth more uniformly againſt all the parts it toucheth of the conſiſtent body, works a far leſs manifeſt change, even on ſoft or tender ſubſtances, than one would expect from the force wherewith it compreſſeth.

6. Thinking fit to try, whether a ſmall quantity of air, without being ventilated or renewed, might not ſuffice to maintain this cold fire, though it will not that of a live coal, or a piece of match; we cauſed a piece of ſhining wood to be hermetically ſealed up in a pipe of clear and thin glaſs; but though carrying it into the dark, we found it had quite loſt its light, yet imagining that this might proceed from its having been over-heated (being ſealed up in a pipe not long enough to afford it a due diſtance from the flame of the lamp we employed to ſeal it) we cauſed two or three pieces of freſh wood, amounting all of them, to the length of about two inches, to be ſealed up in a ſlender pipe, between four or five inches long; which being warily done, the wood retained its light very well, when the operation was over; and afterwards laying it by my bed-ſide, when the candles were carried out of the room, I conſidered it a while before I went to ſleep, and found it to ſhine vividly.

The next morning when I awaked, though the ſun was riſen, yet forbearing to draw open the curtains of my bed, till I had looked upon the ſealed glaſs, which I had fenced with a piece of cloth held between it and the window; my eyes having not yet been expoſed to the day-light, ſince the darkneſs they were accuſtomed to during the night, made me think the wood ſhone brighter than ever. And at night, after ten of the clock, looking on it in a dark place, it appeared luminous in all its length, though not ſo much as in the morning.

The morning after, and the night after that, the ſame wood did likewiſe manifeſtly, though not vigorouſly, ſhine; eſpecially one piece, whoſe light was much more vivid than the reſt: and, for ought I know, I might have obſerved them to ſhine longer, if one of the ſealed ends of the glaſs had not been accidentally broken.

7. I cauſed a piece of iron to be forged, whoſe top was of the bigneſs of a nutmeg; the reſt being a ſtem, of an inch, or an inch and a half long, for which we provided a little candleſtick of tobacco-pipe clay, that would not yield any ſmoak to fill and darken the receiver. Then having heated the iron red-hot, and placed it in this

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This done, we plied the pump again, and obſerved, that as the air in the pipe did, by its own ſpring, expand it ſelf more and more, and grow thinner and thinner, the ſhining wood grew dimmer and dimmer, till at length it ceaſed to ſhine; the internal air being then got much lower than the ſurface of the external quick-ſilver; whereupon opening the commerce between the cavity of the receiver, and the atmoſphere, the quick-ſilver was driven up again, and conſequently the air above it was reſtored to its former denſity; upon which the rotten wood alſo recovered its light. What the greateſt expanſion of this air was, we could not certainly determine, becauſe it raiſed the external quick-ſilver ſo high, as to hinder us from ſeeing and meaſuring it: but we gueſſed that the air reached to about a foot or more, from the top of the pipe, to the ſurface of the quick-ſilver, near the bottom thereof. But when that rarified air was impelled into its former dimenſions, we meaſured it, and found, that the upper part of the tube, unpoſſeſs'd by the quick-ſilver, was about three inches; and the wood being about an inch long, there remained two inches, or ſomewhat better, for the air. But this experiment ought to be repeated, when exacter inſtruments can be procured.

Shining fiſh in vacuo.

10. Thinking it fit to try, as well, whether putrid fiſh that ſhines, be of the ſame nature, as to luminouſneſs, with rotten wood that ſhines too; as, whether the withdrawing of the air will extinguiſh or eclipſe the light of a conſiderable bulk of luminous matter, as in the experiments hitherto made, we found it would do to a ſmall one: we took a fiſh, that we had kept, and caus'd to be watched, till it was almoſt all over luminous; though much more in the belly, and ſome parts of the head, than elſewhere; and having ſuſpended it in a conveniently ſhaped receiver, we found it to give ſo great a light, that we ſuſpected before hand, that the withdrawing of the air would hardly have its full operation upon a body, whoſe bulk was conſiderable, as well as its light very vivid, and which had many luminous parts retired to a pretty diſtance from the air. Accordingly, having exhauſted the receiver, as much as uſual, it appear'd indeed, eſpecially towards the latter end of the operation, that the abſence of the air did conſiderably leſſen, and in ſome places eclipſe, the light of thoſe parts that ſhone leſs ſtrongly: but the belly appeared not much leſs luminous than before. Wherefore ſuppoſing, that upon turning of the ſtop-cock, the air coming in much more haſtily than it could be drawn out, we ſhould have the beſt advantage to diſcern, what intereſt it had in the luminouſneſs of the fiſh, we re-admitted it; and upon its ruſhing in, perceived the light to be, as it were, revived and increaſed; thoſe parts of the fiſh that were ſcarce viſible before, or ſhone but dimly, recovering preſently their former ſplendor.

And

And not to leave unprosecuted the remaining part of the experiment, which was to try, whether the kind of the luminous body, or only the greatness of the bulk, and the vividness of light, and, if I may so speak, the tenacity of the substance it resided in, made the difference between the fish and the wood; we put part of the fish of another kind, that shone much more faintly than that hitherto spoken of, and but in some places; and by the withdrawing the air, we made some of the luminous parts disappear, and the others so dim, as scarce to be discerned; and yet both the one and the other regained their former light upon the return of the air.

And to pursue the experiment a little further, we put in such a piece of the first fish, as though it were bright, was yet but thin, and not considerably broad; and upon pumping out the air, we found it, according to our expectation, quite eclipsed, though it recovered its light upon the air's re-entry.

'Tis probable, that some will make use of this discovery to countenance their opinion, that notwithstanding the coldness (at least as to sense) of fishes, and other animals, there may be in the heart and blood a vital kind of fire, that needs air, as well as those fires which are sensibly hot: which may lessen the wonder, that animals should not be able to live when robb'd of air.

11. To examine the conjecture mention'd in the last experiment, that the durableness of the light in the shining fish, in spite of the withdrawing the air, might proceed in great part from the vividness of it, and the tenacity of the matter it resided in, rather than from the extent of the luminous body, in comparison of the small pieces of shining wood, I had hitherto made my trials with; in *Dec.* 1667. I got a large piece of wood, whose luminous superficies might be, perhaps, ten or twelve times as great as that, which the eye saw, at once, of the surface of such fragments of shining wood, as I used to employ. And though some parts of this large superficies shone vividly enough for rotten wood, (for the light was usually inferiour to that of our fish) yet this great piece being put into a convenient receiver, was, upon the withdrawing of the air, deprived of light, as the smaller ones had been formerly; the returning air restoring its light to the one, as it had done to the other.

12. I took some small pieces of rotten fish, that shone some of them more faintly, and some of them more vividly than one another, but none so strongly as some that I could have employed; and having in a very small and clear receiver so far drawn away the air, as to make the included bodies disappear, we so ordered the matter, that we kept out the air for about 24 hours; and then allowing it to re-enter, in a dark place and late at night, upon its first admittance they regained their light.

NAT. HIST. 13. This, compared with ſome of my former obſervations about putrefaction, put me upon a trial, which, though it miſcarried, I ſhall here make mention of, that in caſe thoſe, who are better furniſhed with glaſſes, think it worth while, they may repeat it. Conſidering how great an intereſt putrefaction hath in the ſhining of fiſhes, and air in the phenomena of putrefaction, I thought it might be ſomewhat to the purpoſe, to take a fiſh, that was, according to the common courſe I had obſerved in animals, not far from the ſtate, at which it would begin to ſhine; and having cut out a piece of it, I cauſed the reſt to be hung up again in a cellar, and the piece to be put into a ſmall and tranſparent receiver, that we might obſerve, if in a day or two, or more, after the fiſh in the cellar ſhould begin to ſhine, that in the exhauſted receiver would alſo ſhine; or, becauſe that ſeem'd not likely, would, notwithſtanding the check which the abſence of the air might be preſumed to give the putrefaction, be found to ſhine too, either immediately upon the admiſſion of the air, or not long after.

But this experiment was only deſigned and attempted, not compleated; the receiver being ſo thin, that upon the exhauſtion of the internal air, the weight of the external broke it; and we could ill ſpare another of that kind from trials, we were more concern'd to make: notwithſtanding which, we made one trial more, which ſucceeded no better than the former, but miſcarried upon a quite differing account, *viz.* becauſe neither the included piece of fiſh, nor the remaining, though it were of the ſame ſort with the fiſhes I uſually employed, would ſhine at all, though kept a pretty while beyond the time, at which ſuch fiſhes uſually grew luminous.

And I will not undertake, that all the experiments another ſhall make with rotten fiſh, ſhall have juſt the ſame ſucceſs with theſe I have related. For, as I elſewhere obſerve, that the event of other experiments is not always certain; ſo I have had occaſion to obſerve the like about the ſhining of fiſhes. And I remember, that having once deſigned to make obſervations about the light of rotten fiſhes, and having, in order thereto, caus'd a competent number of them to be bought, not one of them all would ſhine; though they were bought by the ſame perſon I uſed to employ, and hung up in the ſame place, where I uſed to have them put; and kept not only till they began to putrefy, but beyond the time whereat others uſed to continue to ſhine; yet a parcel of the ſame kind of fiſhes, bought the week before, and another of the ſame kind, bought not many days after, ſhone according to expectation. What the reaſon of this diſappointment was, I could not determine; only I remember, that at the time it happened, the weather was variable, and not without ſome days of froſt and ſnow.

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NAT. HIST.

Being encouraged, as well as pleaſed with this ſucceſs, we forthwith exhauſted the air once more out of the ſame receiver; and having kept it about four hours longer, we looked upon it again in a dark place; and finding no appearance of light, let the air in upon it, whereby it was made to ſhine again, and that vigorouſly enough.

The ſuddenneſs, with which the included body appeared to be, as 'twere, re-kindled upon the firſt contact of the air, revived in me ſome ſuſpicions I have had, about the poſſible cauſes of thoſe ſhort-liv'd apparitions of light (I ſpeak not now of real lamps found in tombs) which diſcloſing themſelves upon mens coming in, and conſequently letting freſh air into the vaults, that had been very long kept cloſe, did ſoon after vaniſh.

'Theſe thoughts, as I was ſaying, occurred to me upon what I have been relating, by reaſon of the ſudden operation of the freſh air, on a body, that but a minute before diſcloſed no light. For though the lights reported to have been ſeen in caves, quickly diſappeared, which that or our fiſh did not; yet that difference might poſſibly proceed from the tenacity, or ſome other diſpoſition of the matter, wherein the luminouſneſs of the fiſh reſides: for I remember, that I have more than once obſerved a certain glimmering, and ſmall ſparks of light to be produced in a ſort of bodies, upon putting them out of their former reſt, and taking them into the air; which ſparks would vaniſh of themſelves, ſometimes within one minute, and ſometimes within a few minutes. But as theſe thoughts were only tranſient conjectures, ſo I ſhall not inſiſt any longer upon them; but rather contenting my ſelf with the hint already given, take notice of what may be more certainly deduced from our experiment; which is, that the air may have a much greater intereſt in many odd phenomena of nature, than we are hitherto aware of.

And, for confirmation of our experiment, I ſhall add, that having, in another receiver, eclipſed a piece of fiſh, that ſhone when 'twas put in more languidly than ſeveral others that we had tried, I kept it about three days and three nights in a receiver; after which, I opened it in the dark, and upon letting in the air upon this body, that ſhone but faintly at firſt, it immediately recovered its ſo long ſuppreſſed light. And having included another piece that was yet more faint than that, when put into the receiver, and having kept this piece alſo three days and three nights in the exhauſted glaſs, I let in the air upon it; and notwithſtanding the darkneſs of the place, nothing of light was thereupon revived. But this being little other than I expected, from a body that ſhone ſo faintly, when 'twas put into the receiver, and had been kept there ſo long; I reſolved to try, whether the appulſe and contact of the air, would have that operation after ſome time, that it had not at firſt; and accordingly, after having waited a while, I obſerved the fiſh to diſcloſe a light, which, though but dim, was yet manifeſt enough.

I ſhall

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I ſhall only add, that having included in ſmall receivers two pieces of rotten whitings, whereof the one, before it was put in, ſcarce ſhone ſo vividly as did the other after the receiver was exhauſted; and having ordered the matter ſo, that we were able to keep out the air for ſome days; at the end of about forty eight hours, we found, that the more ſtrongly ſhining body retained yet a deal of light; but afterwards looking upon them both in a dark place, we could not perceive in either any ſhow of light. Wherefore having let the air into that receiver, wherein the body, that at firſt ſhone the fainteſt, had been put, there did not enſue any glimmering of light for a pretty while: nay, upon the ruſhing of the air into the other glaſs, the body that at firſt ſhone ſo ſtrongly, and that continued to ſhine ſo long, ſhewed no glimmering of light. But within leſs than the quarter of an hour, we ſaw a manifeſt light in the body laſt named, and a while after, the other alſo became viſible, but by a very dim light. The more luminous of theſe bodies I obſerved to retain ſome light twenty four hours after; and the experiment had this peculiar inſtance in it, that the two receivers were uninterruptedly kept exhauſted no leſs than four days, and as many nights.

The light of rotten wood compared with that of a glowing coal.

The things, wherein I obſerved a piece of ſhining wood and burning coal to agree or reſemble each other, are principally theſe five.

1. Both of them are luminaries, that is, give light, as having it (if I may ſo ſpeak) reſiding in them; and not like looking-glaſſes or white bodies, which are conſpicuous only by the incident beams of the ſun, or ſome other luminous body, which they reflect.

This is evident, becauſe both ſhining wood and a burning coal, ſhine the more vividly, as the place wherein they are put is made the darker, by the careful excluſion of the adventitious light.

2. Both ſhining wood and a burning coal need the preſence of the air, (and that too of a certain denſity,) to make them continue ſhining.

This has been prov'd as to a coal, by what I publiſhed in my *Phyſico-Mechanical Experiments*: and as to the ſhining wood, the experiments lately recited, make it needleſs for me to add any other proof of the requiſiteneſs, not only of air, but of air of ſuch a thickneſs, to make its light continue.

3. Both ſhining wood and a burning coal, having been deprived, for a time, of their light, by the withdrawing of the contiguous air, may preſently recover it, by letting in freſh air upon them.

Particular trials have often ſhewn the former part of this propoſition to be true, as when kindled coals, that ſeem to be extinguiſht in our exhauſted receivers, are preſently revived, the air being reſtored to them: and the latter part is abundantly manifeſt by the experiments above mentioned.

4. Both a quick coal and ſhining wood will be eaſily quenched by water, and many other liquors.

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NAT. HIST. The truth of this, as to coals, is too obvious to need a proof, and therefore I ſhall confirm it only as to wood; for which purpoſe, take the following tranſcript of ſome of my notes about light.

I took a piece of ſhining wood, and having wetted it with a little common water in a clear glaſs, it preſently loſt all its light.

The like experiment I tried with ſtrong ſpirit of ſalt, and alſo with a weak ſpirit of ſal-armoniac; but in both, the light did upon the wood's imbibing the liquor, preſently diſappear.

I made the like trial with rectified oil of turpentine, with like ſucceſs. The ſame experiment I tried more than once with high rectified ſpirit of wine, which immediately deſtroy'd all the light of the wood that was immerſed in it; and having put a little of that liquor with my finger upon a part of the whole piece of wood that ſhone very vigorouſly, it quickly, as it were, quenched the coal as far as the liquor reached; nor did it in a pretty while, if at all, regain its luminouſneſs.

5. As a quick-coal is not to be extinguiſh'd by the coldneſs of the air, when that is greater than ordinary; ſo neither is a piece of ſhining wood to be deprived of its light by the ſame quality of the air.

As much of this obſervation as concerns the coal, will be readily granted; and for proof of the other part of it, the following trial may ſuffice.

I took a ſmall piece of ſhining wood, and put it into a ſlender glaſs-pipe, ſealed at one end, but open at the other, and placed this pipe in a glaſs-veſſel, where I cauſed to be put a ſtrongly frigorific mixture of ice and ſalt; but having kept it there full as long as would be requiſite to freeze an aqueous body, I afterwards took it out, and perceived not any ſenſible diminution of its light. But tho' the light of ſhining fiſh be uſually (as far as I have obſerved) more vigorous and durable than that of ſhining wood; yet I cannot ſay, that it will hold out againſt cold ſo well as the other: for having ordered one of my ſervants to cut off a good large piece of a luminous whiting, and bury it in ice and ſalt; when I called for it in leſs than half an hour after, I found it much ſtiffened by the cold, and to have no light, that I could diſcern in a dark place. And for fear that this effect might have proceeded not barely from the operation of the cold, but alſo from that of the ſalt, I cauſed at another time, a piece of whiting to be put in a pipe of glaſs, ſealed at one end, and having ſeen it ſhine there, I looked upon it again, after it had ſtayed but a quarter of an hour, by my eſtimate, in a frigorific mixture, which the glaſs kept from touching the fiſh; and yet I could not perceive, in a dark place, that it retained any light.

1. The firſt difference I obſerved betwixt a live coal and ſhining wood is, that whereas the light of the former is readily extinguiſhable by compreſſion (as is obvious in the practice of ſuddenly extinguiſhing a

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DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

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to the making up one ordinary drop. But in pieces of ſhining fiſh, I found the caſe much otherwiſe, as was to be expected.

6. The laſt difference I ſhall take notice of betwixt the bodies hitherto compared, is, that tho' a quick coal be actually and vehemently hot; I have not obſerved ſhining wood to be ſo much as ſenſibly lukewarm.

What is ſaid of the coal's heat, being as manifeſt as its light, I ſhall need only to make out what relates to the ſhining wood. To aſſiſt me wherein, I meet, among my notes, the following experiment.

I put upon a large piece of wood, which was partly ſhining, and, as near as I could, upon one of the moſt luminous parts of it, one of thoſe thermometers, that I make with a pendulous drop of water. But as I had formerly tried, that by laying the tip of my noſe, or finger, upon it, when it ſhone vividly enough, to enable me to diſcern both the one and the other at the time of contact, I could not perceive the leaſt of heat, but rather an actual coldneſs; ſo by this trial I could not ſatisfie my ſelf, that it did viſibly raiſe the pendulous drop, tho' the inſtrument were ſo tender, that by approaching one finger near it, yet without actually touching it, 'twould manifeſtly be impelled up; and upon the removal of my finger, preſently deſcend again.

And I remember, having put ſuch an inſtrument upon a ſhining fiſh, that was pretty large, I could not thereby perceive, it had any degree of heat, but rather the contrary: and having ſeveral times taken off the glaſs, to apply it with the more advantage to ſeveral parts of the luminous fiſh, I often took notice, that upon the removal of the glaſs into the air, the pendulous drop would manifeſtly riſe a little, and ſubſide again when the glaſs was applied to the fiſh. But whether this part of the experiment will hold in all temperatures of the air, I had not opportunity to try.

Obſervations upon ſhining fleſh.

1. *Thurſday, Feb.* 15. $167\frac{1}{2}$. When I was about to go to bed, an amanuenſis of mine informed me, that one of the ſervants of the houſe, going, upon ſome occaſion, into the larder, was frighted by ſomething of luminous that, notwithſtanding the darkneſs of the place, ſhe ſaw, where meat had been hung up before. Upon this I preſently ſent for the meat into my chamber, and cauſed it to be placed in a corner of the room, made conſiderably dark; and then plainly ſaw, with wonder and delight, that the joint of meat did, in divers places, ſhine like rotten wood or putrid fiſh. The chief circumſtances and phenomena, that I had opportunity to take notice of, at ſo inconvenient an hour, were theſe.

1. But firſt I muſt obſerve, that the ſubject I ſpeak of, was a neck of veal, which had been bought of a country-butcher on the *Tueſday* preceeding.

2. In this one piece of meat I reckon'd diſtinctly above twenty ſeveral places that ſhone, tho' not all of them alike; ſome of them doing it but very faintly.

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3. The ſize of theſe lucid parts was different; ſome of them being as big as the nail of a man's middle finger, ſome few bigger, but moſt of them leſs. Nor were their figures at all more uniform; ſome being inclined to round, others almoſt oval, but the greateſt part of them very irregularly ſhap'd.

4. The places that ſhone moſt, were ſome griſtly or ſoft parts of the bones, where the butcher's cleaver had paſſed: but theſe were not the only luminous parts; for by drawing to and fro the *Medulla ſpinalis*, we found that a part of that alſo ſhone not ill. And I perceived one place in a tendon, to afford ſome light; and, laſtly, three or four ſpots in the fleſhy parts, at a large diſtance from the bones, were plainly diſcovered by their own light, tho' that were fainter than in the parts above-mentioned.

5. When all theſe lucid parts were ſurveyed together, they made a very ſplendid ſhew: ſo that applying a printed paper to ſome of the more reſplendent ſpots, I could plainly read ſeveral ſucceeding letters of the title.

6. The colour that accompanied the light was not in all the ſame: but in thoſe which ſhone livelieſt, it ſeemed to have ſuch a fine greeniſh blue, as I have often obſerved in the tails of glow-worms.

7. But notwithſtanding the vividneſs of this light, I could not, by the touch, diſcern the leaſt degree of heat in the parts whence it proceeded; and having put ſome marks on one or two of the more ſhining places, that I might know them again when brought to the light, I for a pretty while apply'd to them a ſealed weather-glaſs, furniſhed with tinged ſpirit of wine, but could not ſatisfy my ſelf, that the ſhining parts did at all ſenſibly warm the liquor.

8. Notwithſtanding the great number of lucid parts in this neck of veal, yet neither I, nor any of thoſe who were about me, could perceive the leaſt ill ſcent, whence to infer any putrefaction; the meat being judged very freſh, well conditioned, and fit for dreſſing.

9. The floor of the larder, where this meat was kept, is almoſt a ſtory lower than the level of the ſtreet, being divided from the kitchin but by a partition of boards, and furniſhed but with one window, which is not great, and looks towards the ſtreet, that lies northward from it.

10. The wind, as far as we could obſerve it, was then at ſouth-weſt, and bluſtering. The air, by the ſeal'd thermometer, appeared hot for the ſeaſon. The moon was paſt its laſt quarter. The mercury in the barometer ſtood at $29\frac{3}{16}$ inches.

11. We cut off, with a knife, one of the luminous parts, which proved to be a tender bone, about the thickneſs of a half-crown piece, and this appeared to ſhine on both ſides, tho' not equally; and that part of the bone, whence it had been cut, continued joined

NAT. HIST. to the reſt of the neck of veal, and was ſeen to ſhine; but nothing near ſo vividly as the part we had taken off did before.

12. To try, whether I could obtain any juice, or moiſt ſubſtance, from this, as I have ſeveral times done from the tails of glow-worms, I rub'd ſome of the ſofter and more lucid parts, as dextrouſly as I could, upon my hand, but did not at all perceive any luminous moiſture was thereby imparted; though the fleſh ſeemed by that operation to have loſt ſome of its light.

13. I cauſed alſo a piece of ſhining fleſh to be compreſſed betwixt two pieces of glaſs; but I did not find the light to be thereby extinguiſhed.

14. I put a luminous piece of the veal into a cryſtalline vial; and pouring on it a little pure ſpirit of wine, after I had ſhaken them together, I laid by the glaſs, and in about a quarter of an hour, or leſs, I found that the light was vaniſhed.

15. But water would not ſo eaſily quench our ſeeming fires; for having put one of them into a *China* cup, and almoſt filled it with cold water, the light did not only appear, perhaps undiminiſhed, through that liquor, but above an hour after was vigorous enough not to be eclipſed, though looked upon at no great diſtance from a burning candle.

16. While theſe things were doing, I cauſed the pneumatical engine to be prepared in a room without fire, (that the experiment might be tried in a greater degree of darkneſs;) and having conveyed one of the largeſt luminous pieces into a ſmall receiver, we cauſed the pump to be plied in the dark; and perceived, upon the gradual withdrawing of the air, a gradual leſſening of the light; which yet was never brought quite to diſappear, (as the light of rotten wood and glow-worms wou'd have done) or to be ſo near vaniſhing as one would have expected. But by the haſty increaſe of light, that diſcloſed it ſelf in the veal, upon letting in of the air to the exhauſted receiver, it appeared more manifeſtly than before, that the decreaſe, though but ſlowly made, had been conſiderable. This trial we once more repeated, with like ſucceſs; which, though it convinced us, that the luminous matter of our included body, was more vigorous, or tenacious, than that of moſt other ſhining bodies; yet it left us ſome doubt, that the light would have been much more impaired, if not quite made to vaniſh, if the ſubject of it could have been kept long enough in our exhauſted receiver.

17. It was alſo found, that a leg of the ſame veal, had ſome ſhining places in it; though they were but very few and faint in compariſon of thoſe conſpicuous in the above-mentioned neck.

18. *March* 16. Between four and five in the morning, I looked upon a clean vial, that I had laid upon the bed by me, after a piece of our luminous veal was included in it, and found it to ſhine vividly. I looked upon it again the third day, incluſively, after we had

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NAT. HIST. *phori*; we ſhall next proceed to conſider the artificial kind.

the phenomenon is, in ſome degree, owing to the friction of the glaſs; for this being briſkly rubbed with a dry body, will afford a light in a dark place. See *Hauksbee*'s *Phyſico Mechan. Experiments*, p. 6—20, and p. 45—52.

It appears alſo from other experiments of the ſame curious perſon, that light accompanied with heat, is producible *in vacuo*, by the friction of amber upon woollen. And M. *Bernoulli* informs us, that the attrition of a diamond may produce a light as vivid and ſtrong, as that of a glowing coal briſkly agitated with bellows.

"Do not, ſays Sir *Iſaac Newton*, all fixed "bodies, when heated beyond a certain de- "gree, emit light and ſhine; and is not "this emiſſion performed by the vibrating "motion of their parts? And do not all "bodies which abound in terreſtrial parts, "and eſpecially in ſulphureous ones, emit "light as often as thoſe parts are ſufficiently "agitated; whether that agitation be made "by heat, or by friction, or percuſſion, or "putrefaction, or by any violent motion, "or any other cauſe? As for inſtance, ſea- "water in a raging ſtorm; quick-ſilver a- "gitated *in vacuo*; the back of a cat, or "the neck of a horſe, obliquely ſtruck, or "rubbed in a dark place; wood, fleſh, and "fiſh, while they putrefie; vapours ariſing "from putrefied waters, uſually call'd *Ignes "fatui*; ſtacks of moiſt hay, or corn grow- "ing hot by fermentation; glow-worms, or "the eyes of ſome animals by vital moti- "ons; the vulgar phoſphorus agitated by "the attrition of any body, or by the acid "particles of the air; amber, and ſome "diamonds, by ſtriking, preſſing, or rub- "bing them; ſcrapings of ſteel ſtruck off "with a flint; iron hammer'd very nimbly, "till it become ſo hot, as to kindle ſulphur "thrown upon it; the axle-trees of chari- "ots taking fire by the rapid rotation of the "wheels; and ſome liquors mixed with one "another, whoſe particles come together "with an impetus. So alſo a globe of glaſs, "about 8 or 10 inches in diameter, being "put into a frame, where it may be ſwiftly "turn'd round its axis, will, in turning, "ſhine where it rubs againſt the palm of "one's hand apply'd to it: and if, at the ſame "time, a piece of white paper, or white "cloth, or the end of one's finger, be held at "the diſtance of about a quarter, or half an "inch, from that part of the glaſs where "it is moſt in motion; the electric vapour, "which is excited by the friction of the "glaſs againſt the hand, will, by daſhing "againſt the paper, cloth, or finger, be put "into ſuch an agitation, as to emit light, and "make the paper, cloth, or finger appear "lucid like a glow-worm; and in ruſhing "out of the glaſs, will ſometimes puſh a- "gainſt the finger, ſo as to be felt. And "the ſame things have been found, by rub- "bing a long and large cylinder of glaſs, "or amber, with a paper held in one's "hand, and continuing the friction till the "glaſs grew warm." *Newton. Optic.* p. 314—316.

THE

THE

AERIAL NOCTILUCA.

SECT. I.

The ſeveral kinds of artificial phoſphori.

I Here propoſe to ſpeak only of the artificial phoſphori *. And, as far as I have hitherto obſerv'd, thoſe factitious ſhining bodies, that paſs under the name of phoſphori, may be reduced to two principal kinds; one of which may be ſubdivided into two or three. The firſt of theſe conſiſts of ſuch bodies, as ſhine, for ſome time, in the dark, only after being expos'd to the rays of the ſun, or of a vigorous flame; of this kind is the *Bolonian* ſtone, ſkilfully prepared, and the *Phoſphorus hermeticus* of *Balduinus*; which proved therefore very welcome to the curious, becauſe the *Bolonian* ſtone was for ſome years before grown exceeding ſcarce, even in *Italy*. And this, an ingenious traveller, then lately come out of thoſe parts, imputed to the death of the perſon who uſed to prepare the ſtone at *Bolognia*; without having left a ſufficient account of his way of making it lucid. And the phoſphorus of *Balduinus*, which, or the like, may be made both of chalk, and another ſubſtance, ſeem'd to me, when the preparation ſucceeded beſt, to catch the external light far more readily than the *Bolonian* ſtone. For I have had of it, that, when freſh made, wou'd, within about half a minute, be manifeſtly excited, and as it were kindled; ſo that being preſently removed into a dark place, it wou'd retain a very ſenſible light, tho' the external luminary whereto it had been expoſed, were but the flame of a candle.

But as theſe phoſphori cou'd very hardly be preſerv'd for any long time, ſo ſome of them in a few months, and others in a few weeks, wou'd appear crack'd, and loſe their faculty of being excited by the beams of light; whilſt the *Bolonian* ſtone, ſkilfully prepared, wou'd

* "Phoſphori in general, ſays M. *Lemery*, may be looked upon as a kind of "ſponges, full of luminous matter, which "they contain ſo looſely, that a ſmall external force will ſtrike it out, and give it "a luminous form." *French Memoir*. A. 1709. p. 542.

retain

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retain this faculty much longer. For I had a small piece of it, which, tho' kept negligently, in an ordinary wooden box, preserv'd its virtue for several years.

But besides this first kind of phosphorus, which, to be able to shine, must have its faculty excited by the beams of the sun, or of some other actually shining body; there is another sort which needs no such assistance, yet continues to shine far longer than the *Bolonian* stone, or the phosphorus of *Balduinus*. This by some has been called a noctiluca, but more properly a self-shining or luminous substance; and of this Mr. *Krafft*, a *German* chymist, shew'd his majesty two sorts or degrees. To the first whereof, I gave the name of consistent, or gummous noctiluca; this substance being at least as yielding as bees-wax in summer, and its texture not very unlike that of cherry-tree gum. And on account of its uninterrupted action, 'tis term'd by some in *Germany*, the constant noctiluca, which title it deserves; since this phosphorus is by far the noblest we have yet seen. For tho' there were not much of it, and tho' kept by it self, in a little vial well stopped, it would, without being externally excited, incessantly shine, as he affirmed, both day and night; yet the light it afforded, seemed but little, if at all more vivid than I have sometimes observed in the liquor of glow-worms, and other natural phosphori.

Besides this gummous noctiluca, Mr. *Krafft* had a liquid one, that, perhaps, was made only by dissolving the former in some convenient liquor, tho' the lucidness of this was not permanent like that of the other; but within no very long time, especially when 'twas divided into smaller portions, and left exposed to the air, wou'd expire or vanish.

And besides the gummous, and the liquid noctiluca, hitherto mentioned, we may add a third kind that we our selves lately prepared, which seems to be of a somewhat different nature from them both; for ours wou'd not shine of it self, like the constant noctiluca, nor yet after the manner of the liquid noctiluca; but the bare contact of the air, without any external rays or heat, would therein, immediately produce a light, that might easily be made durable in a well-stopped vessel; and which is considerable, the shining substance was not the body of the liquor included in the vial, but an exhalation or effluvium, mix'd with the admitted air; for both which reasons I gave it the name of the aerial noctiluca.

These are the several phosphori that I have yet seen; but future industry may discover some new kinds or variations of self-shining substances, which will deserve new names; and among them, perhaps, that of solid noctiluca's.

The origin of the aerial noctiluca.

After Mr. *Krafft* had shewn me both his liquid and consistent phosphotus; being, by the phenomena I then observed, made certain, that there is really such a factitious body to be made, as wou'd shine in the dark, without having been before illumined by any lucid substance, and without being hot as to sense; I considered in what way it might be most probable to produce, by art, such a shining substance. Mr. *Krafft*, indeed, gave me in return of a secret I communicated to him, a re-

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NAT. HIST. it may be highly valuable, if it ſhall be found conducive to diſcover the nature of light.

But to come to what I here chiefly intend, the obſervations we made upon our noctiluca.

Obſervations made upon the aerial noctiluca.

1. The veſſels not holding entire to the laſt, we had more difficulty than we expected, to get out the ſhining matter; and were obliged to ſave as much as we cou'd of it, by ſmall parcels, in diſtinct vials, whereof, tho' the firſt was judged to contain the moſt vigorous portion of the ſhining liquor, yet I thought fit to make my trials with the noctiluca, ſaved in the ſecond; ſetting aſide ſome more faint and aqueous liquor, that we afterwards ſaved in a third vial; with a thicker matter that remained upon a paper, when ſome of the liquor had been put into it to be filter'd; and this paper we kept in a fourth glaſs, which, tho' wide-mouthed, was carefully ſtopp'd.

2. The ſecond vial was capable of holding about two ounces of water; but it contained not above one ſpoonful of our ſhining liquor; which by day-light appeared muddy, and of a greyiſh colour; ſomewhat like common water render'd opake, by a quantity of wood-aſhes well mixed with it. When no light appeared in the glaſs, we obſerv'd all the cavity that reached from the liquor to the neck, to be tranſparent; as if there were nothing but a ſpoonful of dirty water at the bottom of it. But when the liquor was made to ſhine vividly, all the cavity of the glaſs unpoſſeſs'd by the liquor appeared, in an external light, to be full of fumes; which, being, in the containing vial, removed into a dark place, appeared lucid; and ſometimes like a flame that ſeemed to be reverberated; and to be made, as it were, to circulate by the cloſe ſtopp'd neck, and the ſides of the vial. And the appearance of whitiſh fumes, when the glaſs was look'd upon in an external light, was ſo uſual a concomitant of its fitneſs to ſhine in the dark, that upon viewing the vial by day-light, I cou'd readily tell, by the preſence or abſence of that miſt, whether the matter wou'd, in a dark place, appear luminous or not?

3. When this liquor had been kept for an hour or two, in ſome dark, quiet place, or even in the pocket; if in a darkned room, my eyes were caſt toward the place where the vial was held, I cou'd not perceive it to afford any light at all; and tho' the liquor were ſtrongly ſhook, yet I cou'd not diſcern, that this motion alone was able to bring it, or its vapours, to be manifeſtly lucid. But as ſoon as I unſtopp'd the vial in the dark, there began to appear a light, or flame, in the cavity of it. Whatever be the nature and ſubject of this light, it appeared to have a great dependance on the freſh air: for, (1.) I never obſerved it, either in the liquor, or upon the ſurface thereof; but ſtill the ſhining began at the upper part, which was firſt touched by the outward air, and made a progreſs quick indeed, tho' not ſo inſtantaneous, but the eye cou'd follow it from the top to the bottom of the vial.

(2.) The

(2.) The contact of the air ſeemed neceſſary to the propagation, as well as the production of this flame or light; for if having ſhaken the vial, that the liquor might either wet the ſtopple, or communicate ſomething to it, I warily bent the cork, ſo that only a few particles of the outward air cou'd inſinuate themſelves between the ſtopple and the neck of the glaſs; there would appear on the ſides, and perhaps, beneath the cork, little flames, as it were; which yet, tho' very vivid, were not able to propagate themſelves downwards; but when the cork was quite removed, and aceeſs thereby allowed to a greater quantity of air, the flame or light, preſently diffuſed it ſelf thro' the whole cavity of the vial, and reached as low as the ſurface of the liquor. (3.) Tho' often the light ſeemed more vivid near the ſurface of the liquor than elſewhere, yet when by ſtopping the vial again, preſently after I had open'd it, I endeavoured to deſtroy the flame or light; I generally obſerved, that when it was ready to vaniſh, it began to diſappear firſt at the bottom of the vial, and ſeemed to ſhrink more and more, as it were upwards, till it expired at the neck. (4.) But, on the other ſide, when I kept it unſtopp'd for two or three minutes, tho' I afterwards ſtopp'd the vial very cloſe; the air, that had more leiſure than ordinary to inſinuate it ſelf, wou'd ſo cheriſh the flame, that the light wou'd continue ſometimes for an hour or two, and once or twice it laſted no leſs than three hours. Laſtly; it ſeemed that ſome elaſtic particles of the included air, or ſome ſubſtance that concurr'd to maintain the flame, was waſted or depraved, and weaken'd by being pent up in the vial with the effluvia of the liquor; ſince when the vial had been kept ſtopp'd for a competent time, and its cavity appeared tranſparent in the outward light, if I cautiouſly took out the ſtopple, the external air ſeemed manifeſtly to ruſh in, as if the ſpringyneſs of the internal had been notably weaken'd by the operation of the flame upon the matter with which it was kept impriſoned. And altho' in the vial, moderately ſhaken, when the light was quite vaniſhed, I cou'd not make the liquor begin to ſhine; yet when by unſtopping it a little, the flame was kindled in the cavity of the glaſs; then by ſhaking it again, tho' more faintly than before, the light ſeemed to be manifeſtly increaſed.

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4. If I laid a little of our liquor, when it was in its dark ſtate, upon my hand, or on the ſtopple of the vial, it wou'd often remain there, without diſcloſing any glimpſe of light; but if I rubb'd it with my finger, it wou'd ſhine more vividly than it uſed to do, at beſt, in the vial, when the neck of it was ſtopp'd; and this vivid light, whilſt I continued to rub the matter, ſeemed, from to time, to flame and flaſh; and not only ſmelt offenſive, but viſibly ſent up a large ſmoke, as if it had been ſome common, culinary flame; and when, upon ceaſing to rub the liquor, it had ceaſed to ſhine for a pretty while; yet when I rubb'd it again, it wou'd again appear luminous. But by little and little the lucid virtue decay'd, till 'twas in vain to rub any more.

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5. The light of our liquor, when excited, ſeemed, for degree, much like that obſerved in ſome ſpecies of rotten wood, tho' not the moſt vivid ſort; and when ſurrounded with bodies of a black colour, the reflection of it from them, was little or none. But very white bodies held contiguous to it, were manifeſtly illumined by it; eſpecially if the eye, having been long kept in the dark, was made more ſuſceptible of the fainter impreſſions of light; ſo that waking before break of day, and incloſing both the glaſs and my head between the bed-clothes, the light ſeemed to be very conſiderable, and illumined the compaſs of a foot or more in diameter; and, probably, wou'd have diffus'd it ſelf further, if it had not been bounded by the ſheets; whoſe whiteneſs made the reflection of the light from them appear very prettily. And, by the help of this light, I cou'd eaſily perceive my fingers, and a ring I wore; tho' I cou'd not diſtinguiſh the colours of a reddiſh diamond, and two emeralds, that were ſet in it. With regard to the light within, the included flame of our vial was opake; for both at ſome other times, and when I made the laſt obſervation, I cou'd not at all perceive my finger, when the ſhining ſubſtance was interpoſed betwixt it and my eye. But, in reference to the external light, the flame, or ſhining matter, was tranſparent; for even in a very faint light, by which, I think, I could ſcarce have read an ordinary print; if I held our luminous vial between the window and my eye, I cou'd very plainly ſee my finger on the farther ſide of the glaſs; tho' if my eye were placed between that and the light, the tranſparency would appear ſomewhat leſſen'd; becauſe the cavity ſeemed fill'd with a kind of whitiſh miſt. The like tranſparency, and whitiſh fumes, obſervable in the ſame luminous ſteams or flame, when the vial was look'd on againſt and from the light, I found, if inſtead of the day-light, I employed that of a candle.

6. Having the opportunity of a convenient place, and a fair day, I ſet the vial, about noon, in a window, opened towards the ſouth, and left it there expos'd to the ſun-beams for a conſiderable time; to try, whether they would, upon account of their agitation, or ſome imaginable affinity of nature, kindle or excite the liquor, or its effluvia. But I could not perceive that the ſun-beams had ſuch an operation; nor could I perceive any whitiſh, or miſt-like fumes, in the cavity of the glaſs; nor any light in the vial, placed in the darkeſt corner of the room.

7. Acid and alkaline ſpirits, being reckoned the moſt ſubtile and operative ſubſtances, obtainable from mixed bodies by diſtillation; I thought it worth while to try by the taſt, whether our ſhining liquor abounded with particles of either of thoſe kinds? I did not, however, find, that the liquor I put upon my tongue, was, in the leaſt, acid; nor that it was ſenſibly alkaline, as the ſalts and ſpirits afforded by hartſhorn, blood, *&c.* but it ſeemed to have an odd, empyreumatical taſt, almoſt like the ſpirit of crude tartar; its ſmell reſembling

that

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NAT. HIST. continued ſhining for 12 hours; to which, whether the extraordinary warmth obſerved that particular night, had contributed any thing, I dare not determine; but ſhall rather add, that tho' the phenomenon happen'd very rarely, yet this was not the only time I obſerved it; for once more it occurr'd to me, and then the light continued about fifteen hours, that I took notice of; how much longer it might have laſted, I was hindered from obſerving. But this circumſtance ſeem'd conſiderable, that the long duration of our unburning flame happen'd after the reſt of the trials and obſervations had been made; when by them the vigour of the ſhining matter might reaſonably be expected to have been very much impair'd.

11. But after the foregoing obſervations had been made with our ſecond vial; coming one night to open it, in order to ſhew the phenomenon to a friend, I found no light at all appear, tho' I ſhook the contained liquor, and kept the vial for a pretty while ſtopp'd; till having taken out ſome drops of the liquor, and rubb'd them upon my hand, they offered ſo vivid a light, or flame, as ſatisfied him of the poſſibility of a true noctiluca. And ſince that time I have not found the vial to afford any light, barely upon its being unſtopp'd; ſo that either ſome bodies unſkilful curioſity has, unknown to me, ſpoil'd the liquor; or elſe ſo little a quantity as I had at firſt, is by the many and various trials I made with it, diſpirited and exhauſted.

12. But as the air may concur to the ſhining of our noctiluca, by exciting a certain kind of brlſk motion in the parts of it; I thought fit to try whether, tho' I had found the bare ſhaking of the vial to be ineffectual, yet an actual heat, whereby the parts muſt be more vehemently and variouſly agitated, might not enable the air to do what otherwiſe it cou'd not perform: I therefore held our vial near the fire till it grew conſiderably warm; and then by ſhaking it a little, and unſtopping it in a dark place, I perceiv'd the exhalations that poſſeſs'd its cavity to ſhine as formerly, but their light was very momentary; and tho' afterwards it ſometimes appeared, it was not vivid, nor laſted for a minute, or perhaps half ſo long; tho' it ſeem'd that when freſh air was then allow'd acceſs, its duration was thereby ſomewhat lengthen'd.

I now proceed to our other vials.

Phenomena of another parcel of the aerial noctiluca.

A ſmall portion of liquor, not much exceeding a ſpoonful, that was the firſt I ſaved, being put into a long and ſomewhat ſlender cylindrical vial of cryſtalline glaſs, afforded us the enſuing phenomena.

Soon after the muddy liquor was poured into the vial, it appeared vigorouſly luminous, and continued to ſhine for ten hours, that I took notice of.

And preſuming the ſhining matter was not ſo much the liquor it ſelf, as an aggregate of ſuch effluvia of it, as affected and excited by the air, wou'd become lucid; I thought fit to take particular notice how the air wou'd work upon the exhalations of this more vigorous liquor.

And

And accordingly having fully opened the vial, tho' I very soon after stopp'd it again, I observ'd a great commotion to be made in the cavity of the glass unpossess'd by the liquor; for the new lucid exhalations seemed to have a brisk, and almost circular motion along the sides of the glass, and to make, as it were, a little whirlwind, that impetuously carried it round; and this renew'd rotation was not only manifest, but lasted much longer than one wou'd have expected; so great a commotion did the air seem to have produced in the effluvia, and perhaps in the neighbouring parts of the liquor it self. Upon the ceasing of this unusual motion, the light did not cease; tho' I observed not how long 'twould have lasted. NAT. HIST.

14. Having heedfully taken out the stopple of our vial, in our dark place, after it had, for a long time, ceased from shining; I observ'd the external air to rush into the cavity of the glass with noise, and so swiftly, that it did, I confess, surprize me; as if the preceeding flame, tho' not sensibly hot, had, after the manner of culinary flames, considerably weaken'd the spring of the included air; and so, disabled it to resist the whole pressure of this external air; when, by the removal of the stopple, it was expos'd thereto. But sometimes, when no such eruption of the air had, in a long time, preceeded, I have observed rotations of lucid matter in the cavity of the vial; which therefore seem to proceed from some other cause; tho' this, whatever it be, produced but such a rotation as was less general, less brisk, and less lasting.

15. Whilst our liquor was yet fresh and vigorous, I dip'd my finger in it, and therewith moistened several parts of my hands, and those of others; upon which we observed, that the places touch'd, especially if they were a little rubb'd, shone very vividly, as if actual flames (but not of a blue colour, like that of common sulphur, or of spirit of wine) were burning on them. And these flames were not at all uniform in their manner of burning; for they often seem'd to tremble much, and sometimes, as 'twere, to blaze out with sudden flashes, that were not lasting. And tho' it might seem strange, that so small a quantity of matter, as adhered to this or that part of the hand, shou'd afford so durable a flame; yet if that part were rubb'd against the same person's other hand, or the skin or linen of a by-stander, the part new touch'd wou'd shine as the other continued to do: and tho' these flames were remarkable for their vividness, yet they long continued to afford the company a very pleasing spectacle. And, notwithstanding the darkness of the room, it was manifest, that they emitted great plenty of a whitish smoak, which, or some other effluvia from the same matter, imbued the neighbouring air with a rank and offensive smell. The colour of these seeming flames was not like the phosphorus of *Balduinus*, when 'tis very well prepared, and has been exposed to a vigorous light, red, almost like well kindled charcoal; but yellow, like that of the middle part of the flame of a candle. And notwithstanding the blaze and smoak, that accompanied these flames, we could not perceive in them any sen-

sible

NAT. HIST. sible heat; nor did they at all singe the fine linen of the ladies present, whereon some of them seem'd to burn; so that if we admit a *flamma vitalis* in the heart, this unburning and harmless flame may supply us with a far better illustration thereof, than the scorching flame of spirit of wine, that is still commonly employ'd for an example of it.

16. When with my finger dipp'd in this liquor, I drew short lines upon linen, there was left a shining tract upon that part over which my finger passed; yet having found it too thick, or too faintly lucid, to be employed like ink in an ordinary pen, I tried whether I cou'd draw lucid letters with a pencil, which, for that purpose, I dipp'd in our liquor; but was surprized to find, that the characters I drew did not at all shine in the dark. Suspecting, however, that the pencil might have retained, among the hairs it consisted of, the more tenacious and vigorous parts of the matter it had imbibed, and left only the more aqueous and strengthless parts upon the paper; I took the pencil in one hand, and with the other compressed and wreath'd a little the brushy part of it, to excite the matter, that, probably, was lodged there. By which means, that part of the pencil was brought to look as if it were all of a light-fire, and seem'd to burn like a small wax-taper; but with a more blazing and pleasant flame, which, sometimes, shooting downwards, and playing about the hairs of the pencil, appear'd like the lambent flame describ'd in *Virgil*. But this delightful phenomenon decay'd by degrees, till no more light was seen; after which, nevertheless, the flame would, of it self, break out as if it came from the internal parts of the pencil, shine for a pretty while, and then seem quite to expire; yet still it would, on a sudden, disclose it self again; and when it had continued a while in a tremulous motion, die again to all appearance. And tho' this lambent flame did not, that I perceived, burn or singe the slender hairs, among which it seem'd to blaze; yet it always manifestly emitted as much smoak as a common burning taper of that bigness wou'd have done. This vicissitude of extinction and re-appearance of light lasted till I was weary of observing it; and then having again, with my fingers, compress'd and strongly twisted the hairs of the pencil, I made them, as formerly, afford a considerable light, which I thought was in the action, accompanied with a very sensible, but momentary heat. But notwithstanding this heat, 'twas in vain that I tried, by compressing the pencil first, and then rubbing it upon gun-powder, well dried and heated, to fire the powder. This I fail'd in doing, likewise, when I made the trial with circumstances somewhat more likely to render it successful. And indeed Mr. *Krafft*, when he kindled gun-powder at my lodging, was obliged to use his consistent and constant noctiluca, and to have the gun-powder prepared, by being made so hot, that 'twas almost ready to take fire of it self. But I must not omit what happened to my assistant, when the distillation of our lucid matter had been fresh made; for he having taken up some

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NAT. HIST. to the other, sometimes appeared to have, as it were, a palpitation; and to afford a very unequal light: and tho' when the external air was let in thro' the pump into the exhausted receiver, the flame seemed to be quenched; yet I judge that to be only a temporary effect of the wateriſh vapours, that the air had carried along with it, in its way thro' the pump. I therefore caused the receiver to be taken off the engine; when we observed, that upon the free contact of the freſh outward air, which was not like the former, deprav'd by moiſt vapours, the matter adhering to the paper quickly ſhone again, and that more vividly than it had done in the receiver.

Observations upon a third parcel of the aerial noctiluca.

20. Beſides the liquors that afforded us the foregoing experiments, we ſaved a little of a ſubſtance that was not liquid, yet almoſt as ſoft as mud. This we obtain'd, by pouring ſome of our liquor, taken out of the veſſels, when the diſtillation was ended, into a glaſs funnel, lined with cap-paper; to try, whether it would filtre. But finding that which paſſed thro' too thin and aqueous, the filtre was haſtily wrapp'd up, and put into a ſmall glaſs, but of a moderate wideneſs at the mouth; that both the filtre might be eaſily thruſt in, and the glaſs be exactly ſtopp'd with a ſtrong cork.

21. After other experiments had been made, I carried this glaſs into a dark place; and tho' I could not perceive the leaſt glimpſe of light, yet preſuming that it contained ſome of the true matter of the aerial phoſphorus, and conſequently exhalations, that having been hindered by the ſtopple from flying away, might be kindled or excited by the appulſe of the air; I opened the glaſs, and ſaw an immediate appearance of light, which diſcloſed it ſelf ſometimes upon a leſs, and ſometimes upon a much greater part of the very uneven ſurface of the included paper; and ſeemed to paſs, for a great while, from one part of the filtre, and one ſide of the glaſs to another; with a motion ſo odd and irregular, that it reſembled that of fire kindled by ſparks, ſtruck into a large quantity of tinder: and this ſhining faculty, upon the ingreſs of the air, laſted for many days in the paper.

22. But there was another filtre that offered us a pleaſing variation of this phenomenon; a larger quantity of matter being wrapped up in the inſide of the paper; or elſe being better conditioned, than that which adhered to the former. Having unfolded this paper, and kept it diſplayed in a dark place, we had the pleaſure to ſee a conſiderable number of flames, of different ſizes and figures, diſcloſe themſelves at the ſame time; and tho' moſt of them were vivid, yet few continued long in the ſame place; but they ſeemed frequently to change their ſituations among themſelves, as well as their figures and extent; or elſe new flames inceſſantly broke out in new places, according as the exhalations, that, in plenty, mixed irregularly with the contiguous air in ſeveral places, happened to be, in part, kindled by it; whilſt from the flames themſelves, as well as the unſhining

parts

parts of the filtre, there manifeſtly aſcended plenty of ſmoke, vi- NAT. HIST.
ſible by the light which the ſhining matter afforded; and theſe flames did not keep a conſtant tenor in their blaze, but had their tremblings and emications uſually accompanied with changes of figure, and eruptions of light in ſeveral places at the ſame time; whence 'twas very pleaſant to ſee the whole area of the diſplayed filtre look as the ſky ſometimes does, eſpecially in hot countries; when the eye perceives flaſhes of lightning break out in ſeveral places at once: but our coruſcations being more numerous, made the filtre appear almoſt as variegated as marbled paper; but with this advantage, that the appearance was almoſt perpetually changing; the yellow parts being not only coloured, but lucid; and affording thoſe that looked on them a delightful ſpectacle, as long as we thought fit to gaze on it.

23. Having ſtrongly ſuſpected, that a due agitation of a diſpoſed matter, was one of the chief agents in the production of light; I was led to try, whether a more intenſe heat, which wou'd communicate a briſk and various motion to a multitude of the corpuſcles of the luciferous matter, diſperſed thro' the liquor, wou'd not do what a fainter agitation was unable to perform. I thought alſo, it deſerv'd to be try'd, whether a conſiderable variation of phenomena would not follow, upon changing the figure and capacity of the glaſs, if all immediate commerce between the cavity of the veſſel, and the outward air, were carefully prevented.

In order to both theſe trials, I took ſome ſpoons-full of aqueous liquor, impregnated with ſome of the more ſoluble portion of the luciferous matter; which liquor, when ſettled, was tranſparent, as containing but an inconſiderable quantity of that muddy ſubſtance. And this clear liquor, which being, as it ought to be for my purpoſe, ſo faintly impregnated, that it would not with ſhaking, or a mild heat, afford any light, was put into a round bolt-glaſs, whoſe ſpherical part was capable of holding three or four times as much; and whoſe ſtem was proportionable in wideneſs to it, and above a foot in length. Having carefully ſtopped this veſſel with a cork, and ſealing wax, 'twas in the night-time ſet ſo, that, by the means of ſand, it might be heated without breaking; and when the ball was made too hot to be well endured in my naked hand, I preſently removed the veſſel into a dark place; and having ſhaken the liquor, perceived a light to break out in the ball, which preſently diffus'd it ſelf thro' the whole cavity, and as ſuddenly diſappeared. Some time after, eſpecially upon ſhaking the glaſs, the light would break out again, and ſoon after vaniſh; and theſe flaſhings of light continued for a while to appear now and then; but were unequal as to their extent, vividneſs, and duration: and when the liquor grew cold, they entirely ceaſed.

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24. But whilſt it was yet conſiderably hot, I thought fit to try, whether, upon breaking the liquor by a ſtrong concuſſion, ſome lucid ſubſtance would not be made to paſs out of the ſpherical, into the cylindrical part; and ſo vary the phenomena. And to this purpoſe, having violently ſhaken the liquor at ſeveral times, with pauſes, I perceived ſome conſiderable portions of the lucid matter to aſcend into the pipe; and particularly once I had the pleaſure to ſee a portion of ſhining ſubſtance, about the bigneſs of a ſmall almond, mount directly upwards like a flame, but not very ſwiftly, from the round part of the glaſs all along the pipe, till it reached the upper part of it. And at other times ſuch flames aſcended into the pipe, but not ſo high; whence many wou'd have confidently inferr'd a poſitive levity in flame; which yet I forbear to conclude, becauſe I once, at leaſt, obſerved, one of theſe portions of ſhining matter, to deſcend from the higher to the lower part of the ſtem; retaining its lucidneſs all the time.

Perhaps, by the way, the phenomena appearing in this glaſs, may illuſtrate, or facilitate, the explanation of what happens in the production and motions of ſome of thoſe meteors, that are called fiery; ſuch as the *ignis lambens*, falling ſtars, frequent lightnings without thunder, and that wandering flame called *ignis fatuus*; ſuch bodies being generated when there happens to be a convention of particles ſo aſſociated, that they mutually agitate each other, or are fitted to be agitated, by a pervading ethereal ſubſtance, and put into a motion, like that which in the portions of our ſhining matter, was able to produce light.

25. Having, by a concuſſion fit for the purpoſe, ſpread, as it were, at once, the liquor all over the inſide of the globe, and part of the ſtem; 'twas pleaſant to behold, how the lucid matter, dividing it ſelf variouſly in its paſſage downwards, adorned the whole cavity of the glaſs, with a company of ſmall, lucid bodies, that both ſhone, and twinkled, like ſo many little ſtars: and the pleaſantneſs of the ſpectacle was increaſed, by their having manifeſt motions, as well as true light. The ſlowneſs of their deſcent in lines, many of them very oblique, made this pleaſant ſight laſt the longer. And this experiment we repeated more than once.

26. Having at another time, in a like bolt-glaſs, carefully given a ſtrong ſhake to the included liquor, when 'twas in a due, but an intenſe degree of heat; I obſerved, that on one ſide of the round part of the glaſs, and above the body of the liquor, there was generated, as it were, a great ſpark of lucid matter, about the bigneſs of a pin's head; whence there was quickly a flame, or light, diffuſed thro' the capacity of the globe, where it ſoon after vaniſhed. From which phenomenon, and ſome others of affinity to it, perhaps it may be argued, that this was a true flame, that from a very ſmall beginning was increaſed by propagation, and kindled the diſpoſed exhalation, it found diſpers'd throughout the cavity of the glaſs; or

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NAT. HIST. quality ; ſo that it ſeemed, tho' the air did, after a while, mortifie, as it were, and ſpoil the ſuperficial parts that were expoſed to its immediate contact ; yet this vitiated ſurface ſerved for a kind of cover, or fence, to the matter that lay beneath it, and kept it from evaporating, or ſpending thoſe ſpirituous or ſubtile parts, on account whereof it was capable of becoming luminous.

3. And as I had obſerved, on other occaſions, that liquors abounding in tenacious parts, tho' the liquors did not appear opake or feculent, would leave ſticking to the inſides of the containing glaſſes ſomewhat, that, tho' generally not perceived by the eye, was by ſome other ways diſcoverable ; I ſuſpected even in a vial that had formerly contained ſome of our ſhining ſubſtance, tho' it ſeemed to have been well emptied, and to have no groſs feculency adhering to it, there might adhere ſomewhat which might be made viſible by heat, or motion ; I, therefore, took this glaſs, and having crackt it into fragments, that it might be put into the neck of a vial of a convenient ſhape and ſize, well ſtopt the veſſel, and removed it into a dark place ; we there ſhook it, and had the pleaſure to ſee, not only that light was readily produced by the motion excited in the juſtling of the parts one againſt another, but that by reaſon of the various poſition of the fragments of glaſs, the light ſeemed to be vibrated every way, with a very delightful vigour. This production of a kind of blazing light was often repeated with theſe broken pieces of glaſs ; and if the vial were heated, the effect ſeemed more ſudden and conſiderable : and even by only warming the vial, without ſhaking it, a light would be produced.

4. Afterwards, having beaten ſome of the glaſs into ſuch ſmall pieces as were capable of paſſing through the neck of a glaſs-egg with a flat bottom, that it might ſtand upright ; we hermetically ſealed up the neck, to try whether, by hindering the included matter from exhaling or tranſpiring, we could keep the beaten glaſs always fit to exhibit the phenomenon : but we found not the event anſwer ; for after no long time, we could no more produce any light in our ſealed veſſel ; tho' an unlucky accident in one of our laſt trials, keeps me from being fully ſatisfied that the thing deſigned is impracticable.

5. Some liquid matter was hermetically ſealed up in a bolt-glaſs, to try whether, by this means, we could, for any long time, preſerve the ſhining faculty of that liquor, wherein it was already exceeding faint, and not to be excited but by a conſiderable degree of heat, and a vehement agitation of the veſſel. This ſealed glaſs having been left in the corner of a window, for a competent time, we at length approached the veſſel, by degrees, to the fire ; ſhaking it from time to time, till the included liquor had acquired a conſiderable degree of heat ; then removing it to a dark place, and ſhaking the veſſel ſomewhat ſtrongly, we perceived that the diſpoſition the liquor had to ſhine, was very much impaired, but not quite aboliſhed. For there would, from

from time to time, upon the rude agitation it was put into, appear little portions of matter that looked prettily, and ſhone very vividly, like ſparks of fire: and ſome of theſe appeared in the ſpherical part of the glaſs, and ſome in the neck. Some of them alſo, ſeemed as it were fixed to their firſt ſtation, and others moved up and down, and moſt of them continued to ſhine for a pretty while before they diſappeared: and when they vaniſhed; few of them did ſo by degrees; but each luminous ſpeck, when it had laſted out its time, loſt its whole light at once.

Obſervations upon a new liquid Phoſphorus.

6. Some new liquid phoſphorus being poured into a large vial, that wou'd contain ten or twelve times the quantity; ſo that the ſhining matter, having much air included with it, might thereby be aſſiſted to diverſify, at leaſt, ſome of the phenomena afforded by former noctiluca's: I accordingly obſerv'd in the firſt place, that the ſhining ſteams filled the whole cavity of the large glaſs, that was unpoſſeſſed by the liquor and reſidence; and that this lighter flame continued much longer at once, than any we have hitherto mentioned; for it remained vivid for ſeveral days and nights together, without ever unſtopping the vial to give it freſh air. And I obſerved it to do ſo for about a week, before my occaſions hindered me from regarding it any longer.

7. I ſometimes took notice, that ſome exhalations or vapours, that appeared conſiderably luminous, ſeemed to roll to and fro, like little clouds or aggregates of ſmoak in the cavity of the veſſel; tho' it ſeemed difficult to determine what ſhould give and maintain ſuch a motion in them.

8. The largeneſs of the glaſs being conſiderable, it happened that, ſometimes, when I went into the darkened place where I kept it; ſo much luminous matter would yield a ſurprizing ſight; but tho' its extent were far greater, yet its intenſeneſs did not much exceed that of the light afforded by noctiluca's of the firſt ſort, as we may call thoſe formerly mentioned. Only this I often took notice of, that, in caſe I ſhook the matter gently, the light would appear much more vivid, and, as it were, flaſh, on and about the ſurface of the liquor where it was contiguous to the air, more than it did elſewhere. And this ſplendor was ſuch, that if it had been laſting, I thought it would have made our phoſphorus uſeful for conſiderable purpoſes.

9. When after having, for many days, kept this glaſs ſtopt, ſo that, at laſt, it would no longer ſhine of it ſelf; we ſuppoſed it to be reduced to the condition of a phoſphorus of the firſt ſort; and accordingly found, that, upon the removal of the ſtopple, and ingreſs of freſh air, the cavity would, in a moment, be filled with fumes that look'd white in an enlightned place, but luminous in a dark one; and (probably by reaſon of the quantity of the air contain'd in ſo capacious a glaſs) the light uſually continued much longer than in noctiluca's of the firſt ſort.

10. Being

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10. Being deſirous to try, whether this more vigorous matter, if it were kept ſo exactly ſtopped, that none of the luminous vapours could exhale, would not laſt very long; I put near two ſpoons-full of the liquor, with ſome of the ſediment, into a bolt-glaſs (with a flat bottom) capable of containing near twice the quantity: this glaſs being hermetically ſealed, the included liquor continu'd to ſhine without any external help, either of air or heat, for about ſix days and nights; but then it ceaſed, nor would be made luminous again by moderate ſhaking.

11. After having poured out ſome more of the liquor and ſediment that had been kept in our great vial, into a ſmaller; the remaining matter, having now a greater proportion of air included with it, was very apt to be put into a luminous agitation; and would emit exhalations, that not only fill'd the cavity of the glaſs, but manifeſtly moved to and fro in it, after an odd manner. And being one night willing to give a lady, and ſome other company, the diverſion of a new phenomenon; after having opened the vial, and then ſtopt it again, I ſhook it, and turned it ſo, that, much the greateſt part of the liquor having been before poured out, the reſidence was ſpread over the inſide of the glaſs, to which its particles ſtuck, becauſe there wanted liquor enough to waſh them down: by this means, thoſe little portions of the ſediment being not covered, as uſual, with water, but expoſed to the immediate contact of the air, ſhone much more vividly than the luminous exhalations; and the light being tremulous and twinkling, as well as briſk; they ſeemed to reſemble ſo many little ſtars in a clear dark night, and continued this ſparkling longer than one would have expected, to the delight of the ſpectators; for whoſe ſake the experiment was ſeveral times repeated, and with ſucceſs.

The properties of a new icy noctiluca, or ſolid ſelf-ſhining ſubſtance.

12. Having, at another time, but by a like method, obtained a ſelf-ſhining ſubſtance of a conſiſtent form; I proceed to give ſome account of what I obſerved about it.

(1.) And firſt, tho' this uſually came over in diſtillation, in the form of many little grains, or fragments, differing, for the moſt part, from one another, both in bigneſs (ſome being of the ſize of grains of corn, and others of peaſe, or large cherry-ſtones) and ſhapes, which moſt commonly were irregular; yet when the diſtillation was carried on proſperouſly, we obtain'd the deſired matter in greater lumps; ſometimes as large as ſmall beans, and at others, three or four times as large, but not proportionably thick.

(2.) Theſe lumps, whether ſmall or great, were colourleſs; and uſually when held againſt the light, tranſparent; ſo that many bodies placed beyond them at a convenient diſtance, might be plainly ſeen through them. And ſome of the larger appeared ſo like ſuch fragments of ice, as being thin, are often very clear, and almoſt quite deſtitute of manifeſt bubbles; that becauſe of this great reſemblance, and

for

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NAT. HIST. (though it have lain very long there) it falls to shine again, even whilst 'tis yet dropping wet.

And I have sometimes observed, that when I had so large a piece of noctiluca, that I could conveniently hold one half of it under the surface of the water, and the other half above it, whilst the immers'd part afforded no light, the extant part shone vividly.

Observations upon the water wherein the solid noctiluca was kept.

13. Conjecturing that the water wherein this noctiluca had been long kept covered, to defend it from the air, though it did not manifestly dissolve the mass, might yet be impregnated, at least, with the more saline, and soluble parts of it; I thought fit to make a few trials upon this liquor.

And first, I found that it had a strong and piercing taste, like that of sea-salt; but more pungent, as if brine were mixed with spirit of salt: and it relished also somewhat of vitriol.

14. Being put into a small concave vessel of refin'd silver, upon lighted coals and ashes; it evaporated but very slowly, and would not be brought to shoot into crystals, nor to afford a dry salt; but coagulated into a substance, sometimes like a gelly, and sometimes, as to consistence, like the whites of eggs: which substance was easily melted by heat.

15. When this substance was kept a while on a hotter fire, it only boiled at first, but soon after began to make a crackling noise; whilst the explosions were accompanied with flashes of fire and light; which, if small, were generally very blue, like the flames of sulphur, but more vivid, and sometimes also more blue; but the greater cracks, whose noise was considerable, gave a yellow colour, and a very strong light. And these phenomena did not only happen whilst the matter was boiling over the fire, but a pretty while after the vessel was taken off, and held in the air.

16. If, before the coagulated matter was too far wasted by the heat, it were suffered to cool a little, it appeared to have acquired a consistence like melted rosin, or rather, stiff bird-lime; for it would draw out into threads of, perhaps, a foot, or more, in length; and having held one of these threads to the flame of a candle, it did not take fire, but melted into little globules, like capillary threads of glass. And having made some of them stick to the wieck of a candle, towards the bottom of the flame; they coloured the lower part of the flame, quite round, with a very fine blue, which lasted much longer than one would have expected.

17. This glutinous substance had, by the action of the fire, acquir'd an odd kind of strong smell, almost like that of garlic; and being left all night in the air, attracted the moisture of it exceeding fast; appearing dissolved, in a great measure, into a liquor almost as strong as spirit of salt.

18. Putting this substance again over the fire, as before, it appeared to be very fix'd; for though there were not so much as a spoonfull

full of it, yet it continued boiling for a great while, and afforded a multitude of ſhining exploſions, ſome whereof made a conſiderable noiſe, and gave notable flaſhes of light, which ſeemed to proceed from condens'd and agitated fumes, ſuppreſſed by the hardned ſurface of the matter, and kindled in their eruption into the air; whither ſome parts of theſe fumes, that were not kindled, eſcaped, in the form of ſmoke, whoſe ſmell was very ſtrong and rank, but of a peculiar kind. And what ſeemed ſtrange, though often two, and ſometimes more flaſhes appeared at once, yet ſo ſmall a quantity of matter continued to afford them for almoſt an hour together; and, probably, would have done ſo longer, if I could have watched it. NAT. HIST.

In what liquors the icy noctiluca is, or is not diſſolvable.

19. Among other ways of diſcovering the nature of our icy phoſphorus, I thought fit to try, whether it would diſſolve in ſome liquors of different kinds, from whence we might gueſs at its texture.

We found then, that common water would not, in the cold, diſſolve it, though the liquor was thereby impregnated; as when *Crocus metallorum*, or glaſs of antimony, being infuſed in wine or water, the menſtruum is impregnated with emetic particles; tho' the bulk, ſhape, and colour of the *crocus*, or the glaſs, are not thereby viſibly diminiſhed or altered.

20. We afterwards put a grain or two of our lucid matter, into a little ſpirit of ſal-armoniac; but this ſeemed not to make any conflict with it, nor manifeſtly to work upon it; though, to give the liquor time to make a ſolution, we left them together for ſeveral days. But as ſoon as we had poured off the ſpirit, it appeared that it had not by any contrariety, deſtroyed the power of the noctiluca, which began readily to ſhine as formerly; and yet might be immediately ſuppreſſed again, by ſuffering the liquor to cover it as before; but when we had, by keeping the vial, for ſome time, in a moderate heat, impregnated the liquor with it; this liquor, being then dropt into water, had a like effect with that hereafter to be mentioned in the experiment with impregnated ſpirit of wine.

21. Seeing a volatile and urinous ſalt would not work ſenſibly upon our phoſphorus, we thought fit to try, what corroſive liquors would do; and accordingly, put a grain or two of our ſplendent matter into a very ſmall vial, wherein was a little oil of vitriol; that menſtruum appearing, in many caſes, more corroſive than other vulgar acids; but neither did this menſtruum diſſolve our icy noctiluca, in the cold; and therefore putting it in ſome heat, we found, that though it did not manifeſtly diſſolve the ſhining matter, yet the warmed oil made it melt, and appear, at leaſt for the time, a fluid body; in which it ſeemed remarkable, that this ſo fugitive a ſubſtance, ſhould be ponderous enough to lie at the bottom of oil of vitriol; one of the heavieſt fluids we know, except quick-ſilver.

22. Afterwards we put a ſmall fragment of our icy phoſphorus into *Aqua fortis*; and though we kept it in that menſtruum for two

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or three days, and ſet the containing vial, for many hours, in a warm place; yet we found the matter ſo little altered, as to its viſible appearance, that we doubted, whether the liquor had diſſolved any ſenſible quantity of it.

23. I put a little of our noctiluca into ſome oil of turpentine; which not diſſolving it in the cold, the ſmall vial that contained it, was left all night upon warm aſhes. But though the next day none of the phoſphorus appeared any longer in the glaſs, yet we could not perceive, by two or three different trials, that the oil was much altered by it; and particularly I obſerved, that though the glaſs was unſtopt, and kept ſo for a while, yet the ingreſs of the air did not produce any ſenſible light: nor did we perceive the upper part of the glaſs to be full of white fumes, as is uſual in ſeveral other liquors impregnated with our noctiluca, when they are unſtopt.

24. It has rendred the experiments made with the aerial noctiluca much leſs acceptable, than otherwiſe they would have been, to the delicate ſort of ſpectators, that the light produced was accompanied with a very unpleaſant ſmell, that iſſued out of the vial whenever it was unſtopped, to let in the air. But by the help of our icy noctiluca, I found a way to prevent this ungrateful concomitant of our artificial light. For having, in a very ſmall vial, put about a grain of noctiluca matter, and covered it with as much pure eſſential oil of cinnamon, as wou'd ſwim leſs than a finger's breadth above it; we carefully ſtopt our little vial, and having warily held the bottom of it againſt a fire, till the phoſphorus began to melt, I ſuffered it to cool; and then unſtopping it in a dark place, had the pleaſure to ſee a vaniſhing indeed, but a vivid light. So that, by this means, I could afterwards ſhew the production of light to the niceſt perſons; adding to the pleaſure of a delightful phenomena, that of a fragrant ſmell. But becauſe oil of cloves is more eaſie to be had good, than the oil of cinnamon, and is alſo much cheaper, I tried the experiment more fully with that.

25. We put ſome of our luminous ice, into a little pure oil of cloves; but found, after a conſiderable time, that, at leaſt, a great part of the matter was undiſſolved; yet the liquor was richly impregnated with it; as we found by a pretty phenomenon that it afforded us. For the little vial it was kept in, being opened in a dark place, there immediately enſued a kind of flaſh of light, far more vivid, its ſmall bulk conſidered, than any liquor had yielded us before. But the brightneſs of this appearance was, it ſeems, too great to be laſting; for the flame-like ſubſtance uſually expired in leſs than a minute; and ſometimes, perhaps, in half that time. And there were two other circumſtances particular enough in this phenomenon; one, that ſometimes, eſpecially if a candle were in the room, the ſhining fluid would appear of a pleaſant, and ſomewhat ſurprizing bluiſh colour: the other, that the light would ceaſe, whilſt there yet

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NAT. HIST.

30. And firſt, I obſerved, that it did not manifeſtly diſcolour the liquor, but left it tranſparent and limpid, as before; only there appeared ſome very ſmall earthy corpuſcles, like duſt, at the bottom of the liquor, when being a little ſhaken, it was attentively view'd.

31. We did not obſerve that, upon unſtopping the vial, and the restored commerce between the inward and outward air, there appeared any flame or luminous exhalations, as is uſual upon opening vials that contain the liquid aerial noctiluca.

32. But having, in a dark night, dropt a little of this impregnated ſpirit into a ſmall *China* cup, with common water in it; tho' the ſpirit neither in the vial, nor in its paſſage through the air, diſcloſed any degree of light, yet as ſoon as ever the drops came to touch the liquor, they would be as it were kindled by the cold water, and afford little flaſhes of light, more vivid than the noctiluca it ſelf; giving a ſplendor that render'd not only the brims of the cup, but many of the neighbouring objects manifeſtly viſible. Theſe coruſcations had the property of other lightning, to vaniſh almoſt as ſoon as they appeared; nor would the water, that produced them, by being agitated, ſhine; but others might immediately be produced, by letting freſh drops fall into the ſame water; upon whoſe ſurface they ſeemed to diffuſe themſelves; and they would ſometimes leave thereon, for a little while, a faintly luminous film or membrane.

I alſo thought fit to try, whether our phenomenon would not be produced with hot water as well as with cold; and accordingly found that the impregnated ſpirit of wine produced rather a greater than a leſs light in hot water than it had done in cold.

33. At another time, having, in a very good balance, weighed out one grain of our noctiluca, (firſt wiped dry) we put to it, at ſeveral times, that it might the better diſſolve, above two thouſand grains of ſpirit of wine, that would burn all away; and yet, which may ſeem ſtrange, this ſmall quantity of noctilucal matter did ſo impregnate all the liquor put upon it, that tho' nothing of luminous appeared in the menſtruum, nor in any exhalations riſing from it, if the vial were unſtopped, or the liquor poured out of it into the air; yet as ſoon as ever 'twas dropt into common water, there would be produced a vivid appearance of light, ſuch as we lately mentioned.

It ſeemed not very improbable, that theſe ſudden and vaniſhing flaſhes might, in great part, proceed from the quick diſengagement and extruſion of the noctilucal particles, made by the water; which, diluting the vinous ſpirit, diſabled them from retaining the luciferous corpuſcles: as if into one ounce of high rectified ſpirit of wine, you put half a dram, or a dram of camphire, the liquor will diſſolve it, without being thereby manifeſtly altered as to colour, or tranſparency; but if you drop this ſolution into common water, the vinous ſpirit will immediately diffuſe it ſelf into the liquor, and let go the corpuſcles of the camphire, which float like a white powder upon the ſur-

surface of the water. And, accordingly, our impregnated spirit of wine being dropt into some other well deflegmed spirit of wine, we saw no light produced; but when it was dropt into spirit of sal-armoniac, which seems to consist of the volatile salt dissolved in the phlegm or aqueous liquor, the noctilucal corpuscles were by this wateriſh part freed from the vinous spirit, almost as much as they would have been by common water, and did, accordingly, shine with much briskness.

A strange subtilty of parts in the glacial noctiluca.

34. And after having brought one grain of our shining matter to impregnate between four and five ounces of highly rectified spirit of wine, which did, at least, two thousand times exceed the weight of the noctilucal substance; I presum'd that this very parcel of spirit of wine, wherein it was already diffused and scattered into so many thousand corpuscles, as sufficed to impregate all the liquor, would yet communicate to a large quantity of water-particles enow to make it shine, when agitated. Wherefore, when we had weighed out, in a very exact balance, one dram of our impregnated spirit, we mixed it with, and shook it in as much fair water as we thought fit, (but not all at once) till we had to our dram of spirit of wine, put above fifty times its weight of water; and this spirit it self weighing, at least, two thousand times as much as the noctilucal matter, wherewith 'twas impregnated, it follows, that the single grain of icy noctiluca was able to diffuse it self through, and impregnate full a hundred thousand grains of liquor, so as (when duly ordered) to make it luminous. For having presently after the last water was put into the glass, stopt the vessel close with a cork, and shaken it a little in a dark place, the whole vial appeared to be full of light; which tho' it were not more than ordinarily intense, yet by reason of the bulk of the liquor, made a glorious shew, and discovered many of the neighbouring objects. And after we had done shaking the vial, not only the upper part, which was fill'd with exhalations and vapours, shone like those other liquid phosphori formerly mentioned; but, what was not observed in them, the water it self had a luminousness, tho' of an inferior degree, of its whole mass; for when the glass was shaken, all the liquor appeared to shine, so that we could plainly see through the sides of the vessel, the conical figure of its bottom.

After this, I prosecuted the experiment further, increasing the proportion of the water to fresh impregnated spirit; and found, that one part of the noctiluca, being first dissolved in spirit of wine, and afterwards briskly shaken into a convenient quantity of water, rendred as much liquor luminous, as, upon calculation, amounted to four hundred thousand times its weight. And this did not seem to proceed from the irradiation of the luminous corpuscles or exhalations, shining in the empty space at the top of the glass; because the vial was so near fill'd with liquor, that there was but little room left for vapours; and because, also, the vapours that play'd in that space, shone but very faintly; and when the glass was at rest much less than a minute, the

light

NAT. HIST. light would reach but a little way downwards in the water, and yet was there ſo dim, as to be ſcarce diſcernable. But in our experiment, not only the agitated liquor appeared luminous throughout, but the light was briſk.

But leſt ſome ſhould think, that if this experiment had been ſtill further proſecuted, the luminouſneſs would have ſtill extended to greater quantities of water; I ſhall add, that when I increaſed the proportion of this liquor to the noctilucal matter, to be diſperſed through it, by putting in near three or four ounces of water, more than I gueſſed would be convenient; the luminous matter ſeemed to be, as it were, drowned or loſt in ſo much liquor; for tho' we gave it much more agitation than had, in the former experiments, produced light; yet no luminouſneſs at all appeared in the freſh ſpirit: and ſhaking it into ſuch a quantity of water, as I thought it might ſerve to impregnate, I found that the luminous maſs of liquor, thereby produced, amounted to more than five hundred thouſand times the weight of the noctilucal matter diſperſed through it; which is a viſible expanſion very much greater than, I think, has been hitherto obſerved in any corporeal ſubſtance diſſolved in a viſible liquor; ſince it four times exceeds that I made with cochineal, and which has been taken notice of as a prodigious thing; one part of the cochineal, having in that experiment produced a diſcernible colour in an hundred twenty-five thouſand parts of water.

But I here only deliver the manifeſt impregnation of the water it ſelf, which is a groſs and tangible liquor, by the diſperſed particles of the noctilucal matter; and have made no eſtimate of the incomparably greater expanſion of the light, that from the matter included in the vial, illuminated the ambient air, to a conſiderable diſtance from it; tho' by reaſon the darkened room was not large, I was diſabled to make an eſtimate how far the enlightened ſphere of air might have extended.

Beſides, this experiment was not favourably made; ſince we purpoſely weighed out ſomewhat leſs of the lucid matter, and now and then more of the water, than the preciſe quantities our calculation ſuppoſes.

And laſtly, upon ſearch I found, that the grain of icy phoſphorus, firſt put into the ſpirit of wine, we made uſe of all this while, was not, tho' after ſo long a time, totally diſſolved; a ſmall fragment, amounting to about an eighth part, if not more, remaining at the bottom of the vial; upon which having poured ſome freſh ſpirit of wine, and kept it a while in a little heat, to further the diſſolution; that liquor grew very luminous, when dropt into common water: whence it ſeemed probable, that if the whole grain of icy phoſphorus had been diſſolved at firſt in the ſpirit of wine, it would have impregnated above ſix hundred thouſand times its weight of water, ſufficiently to make it ſhine.

I come

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36. Now as I had ſet the glaſs, and kept it in a ſhelving poſture; I thereby preſerved the ſaline part of the ſhining matter, a liquor which I thought fit to examine.

In order to this, I put all the remaining clear liquor, or *Caput mortuum*, into a ſmall concave veſſel of well-refined ſilver. And our liquor being, in this veſſel, ſet upon ſome ſmall coals and aſhes, did not evaporate near ſo eaſily, as one would have thought; but turned into an unctuous ſubſtance, of a dark reddiſh colour; wherefore, we placed the veſſel upon quick coals, that by their brisk heat they might make the liquor boil, and free it from ſuperfluous moiſture. By this means, after a while, it was reduced to a ſubſtance, that afforded us a pretty phenomenon. For the boiling liquor crackled like a handful of bay-ſalt caſt into the fire; and whilſt theſe cracklings continued, which they did much longer than one would have expected, they imitated little volleys of ſhot, not only in the great number of the ſounds they made, but in the little flaſhes that accompanied them; which, when the fire was ſomewhat increaſed, were ſo many, and followed one another ſo faſt, that they appeared to make up a continued flame, pleaſant to behold.

37. I had, afterwards, a mind to make ſome eſtimate, how far the breaking of the ſhining matter into fragments, and the conditions of the veſſel, contributed to the quick conſumption of it. To this purpoſe, we took a lump of three grains, carefully weighed out, and put it into a ſmall glaſs funnel, whoſe upper end was wide and capacious with regard to the lower part, which was exceeding ſlender, that the noctiluca might have air both above and often below; yet the matter not ſlide down, till it were ſo waſted, as to be leſs than a ſmall pin's head. A veſſel of this ſhape I choſe to make uſe of, that I might catch the liquor, that would be afforded by the deliquation of our icy phoſphorus; for which purpoſe the ſlender pipe of this funnel was put into the orifice of a ſmall cylindrical vial; and there kept in a quiet place; which was a ſouth window; from whence every night, after I was in bed, I cauſed it to be brought into my chamber, to ſee if it continued to ſhine. By which trials, I found that it remained luminous, and was not yet ſo waſted, as to fall quite through the funnel into the vial, at ſomewhat beyond the end of the fifteenth day; ſo that it continued to ſhine for three hundred and ſixty hours.

What has been hitherto related, may juſtly make a man reflect, with ſome wonder, upon the ſtrange minuteneſs and multitude of parts, that are crowded together in our noctilucal matter; if we conſider what a multitude of luminous beams of viſible ſmoke, and of odorable effluvia, ſo ſmall a quantity of it as three grains, could inceſſantly afford for two or three hundred hours; leaving, after all this, behind it above three times it weight, (for ſo we found it to be) of a liquor, which it ſelf was not a cadaverous one; or,

what it looked like, common water; but was, very probably, impregnated with many ſaline parts, and not a few capable of ſhining briskly. NAT. HIST.

38. I took a little of the conſiſtent noctiluca, and having broke it, and, as its brittleneſs would permit, ſpread it here and there upon a piece of folded paper; I lighted that paper at the flame of a candle, and obſerved, that when the flame reached any little fragment of the ſhining matter, it would take fire, and burn away in a flaſhing and very ſputtering manner, accompanied with noiſe; almoſt like grains of ſalt-petre, when thrown upon a live coal. *The inflammability of the noctiluca it ſelf.*

39. I obſerved alſo, that if I put pieces of paper, on which I had placed ſome of theſe grains of noctilucal matter, upon ſome embers covered with aſhes; before the paper itſelf took fire, the ſhining matter would communicate its flame to the contiguous paper.

40. We put a fragment of our ſhining matter, not amounting to a grain, into half a ſpoonful, or leſs, of highly rectified ſpirit of wine, and kindled that liquor with the flame of a candle, the ſpirit burned away, as is uſual, in a flame partly yellow, but chiefly blue: and though the heat of the ſilver-ſpoon, wherein the trial was made, quickly melted the noctilucal matter, and gave it a globular form; yet it continued at the bottom, without manifeſtly mixing with the vinous ſpirit, or conſiderably altering the colour of its flame. But when the ſpirit of wine was all conſumed, without leaving the leaſt phlegm behind it, the laſt drops coming, when they were actually kindled, to touch the ſhining matter, they preſently ſet it on fire; but its flame was very different from that of the vinous ſpirit: for, beſides ſomewhat odd in its figure, its colour was not at all blue, or bluiſh, but of an intenſe yellow; and burned ſo fiercely, and with ſo vivid a light, that it was ſurprizing to behold: it alſo continued to burn for a pretty while, conſidering the ſmall quantity of the combuſtible matter. And whilſt it burned, it emitted plenty of ſmoke, that ſeemed to be darted up to a conſiderable height. The matter did not burn all away, at once, but left a kind of *Caput mortuum*, which lay in the form of a little cake, partly of a deep yellow, and partly of a fine red. This matter being very bulky, in proportion to what was conſumed, I proceeded to burn it after another manner, till there remained only ſome very few light feces, that ſeemed to be of the ſame nature with thoſe in the following experiment.

41. We took a ſmall fragment, not amounting to a grain, of the noctilucal matter; and putting it into a ſilver-ſpoon, we caſt upon it the ſun-beams collected by a ſmall burning glaſs; whereby it was preſently ſet on fire, and afforded, together with a great deal of ſmoke, a flame exceeding yellow, and ſo very fierce and bright, that it was conſpicuous, though, the window being purpoſely ſet open, the beams of the ſun, then in the meridian, were ſuffered to beat full upon it: a brisk wind alſo blew upon it without extinguiſhing it. At the bot-

NAT. HIST. tom of the ſpoon, the expiring flame left a round and broad *Caput mortuum*, conſiſting of ſeveral circles, like thoſe of a ſardonyx, the largeſt whereof was white, another yellow, and the third red; all the three colours being pleaſant and vivid. Some part of this *Caput mortuum*, being freely touched by the air, appeared combuſtible; and the reſt being left in the ſpoon, that the air might work upon it, did, for the moſt part, ſoon reſolve it ſelf *per deliquium* into a liquor, almoſt as ſharp as ſpirit of ſalt; the reſt remaining a light black feculency; of which, becauſe there was ſo very little, we could make no trial. But ſo much matter could not be left unfired, unleſs ſomething hindered its accenſion; for when we warily turned over the little cake with the point of a knife; the under part, being, I preſume, hot, preſently took fire upon the contact of the air, and flamed away, till the matter was almoſt totally conſumed.

42. We put two grains of our dried noctilucal matter into a glaſs mortar, whoſe coldneſs and thickneſs were able to keep it from being put into any ſenſible heat, by the operation that was to be performed in it; and conſequently, from communicating any heat of its own to the noctilucal matter. This we pretty briskly rubbed in the mortar, with a glaſs peſtle; but though it was thereby brought to ſhine much more vividly than before, yet it did not take fire; which I was apt to impute to the great coldneſs of the glaſs; but at length it took fire, and began to burn away in an actual flame, with much ſmoke: this, however, did not laſt ſo long as might have been expected; probably, becauſe the veſſel continued ſenſibly cold; and perhaps alſo, becauſe of the narrowneſs, and depth of it, which ſomewhat hindered the free acceſs of the air; for ſome matter, that was taken out on the peſtle, ſeemed to burn better than that which remained in the mortar; and this being extinguiſhed, was once more kindled by trituration; but ſoon expiring again, could not by the ſame means be re-kindled, only it ſhone briskly.

Experiments about burning other bodies with the noctiluca.

43. If our phoſphorus be for any time preſſed hard between the fingers, or againſt a board, or ſome ſuch hard, and not very cold body, it will often feel actually and very ſenſibly hot; and ſometimes the degree of heat will be ſo vehement, as to ſcorch the ſkin, as my venturous aſſiſtant found ſeveral times to his pain; his fingers being almoſt covered with bliſters, raiſed on them by handling our ſhining matter: he alſo complained to me, that, though he had been often burned on other occaſions, yet he found bliſters excited by the phoſphorus, more painful than others; and he is not the only perſon, who has complained of finding the burns made with this matter, to be more tedious and difficult of cure than ordinary ones. But, as our noctiluca was not always made of the ſame matter, nor with care equally ſucceſsful; ſo I obſerved its diſpoſition to burn, and the degrees of heat, to which it would be brought by motion, to be different; upon which account, I did not find, that

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at once, with a great blaze, like fired gun-powder; only the flame appeared more luminous.

48. The highest effect of the heat of our icy noctiluca, was casually produced by my assistant; who being desirous to try, whether some that was newly prepared, were good, began to draw letters with it, upon a piece of plank, that had been long used in the laboratory, as part of a stove; and, chancing to ptess the matter hard upon this board, that the constant heat of the place had brought to an unusual degree of dryness, he found, to his surprize, that he had not only shining, but burning letters; the lucid matter having actually set on fire those parts of the wood, against which he had strongly pressed it.

Whether the solid noctiluca be an alkali, or an acid, examined.

49. To examine, particularly, what family, or sort of salts, the saline part of our noctilucal matter either belong'd, or had most relation to, I suffered a little of it to resolve *per deliquium* into a clear liquor, and then made therewith some of the tryals, by which I usually examine what species a salt belongs to. And guessing this liquor by the tast, and the manner wherein it was made, to be somewhat, tho' not altogether, of the nature of spirit of sea-salt; I dropt a little of it upon a convenient proportion of syrup of violets, and found that it turned it not green, but of a fine carnation colour. I found also, that a very little of our liquor, presently destroy'd the blue colour, and not the other of a tincture of *Lignum nephriticum*.

50. I, likewise, put some of this liquor of the noctiluca, upon filings of copper; which, being thoroughly drench'd, and some of them cover'd with it, I exposed them in a hollow glass for two or three days to the air: and by this means had, without the help of heat, a solution of some of the filings, the colour of which seemed to partake of green and blue.

51. To make the saline nature of this liquor the more manifest, I put some of it upon powder of red coral, which it presently corroded with noise and froth; and putting another parcel of the same liquor, upon some dry salt of tartar, there immediately ensued a fierce conflict between them, whereby some noise and much froth was produced; so that I thought it needless to waste any more of the noctilucal matter, to make it farther apparent, that our liquor was not, as most chymists would have expected, of an urinous nature, but belong'd to the family of acid salts; and seemed to be near of kin to that branch of them, to which the spirituous part of common or sea-salt belongs.

Phenomena of this phosphorus in glosses hermetically sealed.

52. I put some of our dry phosphorus into a clear vial, able to hold about an ounce of water; and having very carefully closed this glass, I laid it aside, and observed it to continue to shine for some few days; after which the light manifestly decayed, and soon after quite disappeared; tho' I thought it possible, that it did not expire so soon as it ceased to be visible; because the whitish fumes, emitted by the matter, whilst it continued to shine, had covered the inside of the

glaſs, with a kind of whitiſh ſoot, that, at length, darkening it, might well hinder a faint light from pervading the veſſel, and reaching the eye. But it ſeems, that the air included with the phoſphorus, either had ſome vital ſubſtance (if I may ſo call it) prey'd upon thereby, or elſe was by the fumes of the phoſphorus, to name no other poſſible ways, tamed, and rendred at length unfit to continue the particular flame of our noctiluca. NAT. HIST.

53. Yet to purſue the deſign of making a light more laſting than ordinary, by keeping the matter from the external air; I took ſome of our noctilucal matter, that came over with the aqueous, from which 'twas not ſo eaſily ſeparable, but that I thought it beſt to leave them together, (in regard that it ſhone ſo well, that it might paſs for an excellent portion of the aerial noctiluca;) and this we ſealed up in a glaſs-egg (whoſe bottom had been made flat) and ſetting it in a place, where it would be frequently in my eye, I obſerved it from time to time, eſpecially at night, and found it continue to ſhine for a week, or longer; and this with ſo little decay of light, that I was ſurprized, when, coming in the night-time to look upon it, I found it to ſhine no more; eſpecially ſince I could not reſtore any manifeſt light to it, either by agitation, or by moderately warming the ſealed glaſs, that contained it.

54. After many obſervations made of the degrees of light, that our icy noctiluca afforded, as 'twere of its own accord, without external heat; I thought fit to try, whether, by the application of a moderate heat of the fire, the light might not be much invigorated, and perhaps the phoſphorus it ſelf be brought actually to kindle, even in a cloſe veſſel. We took, therefore, ſome grains of our conſiſtent phoſphorus, and put them into a round glaſs-egg, ſomewhat larger than an ordinary hen-egg, fitted with a ſtem of a proportionable bigneſs, and about two thirds of a foot long. This being hermetically ſealed up, the round part of it was warily, and, by degrees, warmed at the fire; and then we inſtantly removed it into a dark place, where the included matter, not only ſhone much more vividly than before it was heated, but ſome portions of it were brought to an actual flame; as appeared both by the radiant ſplendor of the burning matter, and by the condition of the ſmoke it emitted; and yet more manifeſtly, by the intenſe heat which the flaming part of the matter, communicated to that part of the glaſs whereto it adhered; for there, the veſſel was not to be ſo much as touched without inconvenience: and when this flame expired, which it did after no long time, the portion of the matter, lately kindled, no more ſhone or burnt as before; but was reduced to the condition of the reſt of the noctilucal matter, together with which it, for a while, retained a conſiderable degree of light, upon account of the heat it had been expos'd to, over and above that luminouſneſs which ordinarily belonged to it.

This

NAT. HIST. This experiment appeared ſo ſtrange, and was ſo delightful, that, to gratify the curious, and purſue my own deſign, 'twas repeated within the compaſs of a month or two, between twenty and thirty times; the ſame matter being ſtill kept in the ſame veſſel: tho', by being melted, and in great part ſublimed by its frequent approaches to the fire, it was divided into ſeveral parcels. But that made the experiment ſo much the more pleaſant, in regard that ſometimes more than one, or, perhaps, than two portions of the matter would ſeem to burn at once. This was looked upon as a very new and ſcarce credible thing, that a perſon ſhould be able to bring a body to burn with an actual flame, and for no inconſiderable time, in a glaſs hermetically ſealed, and not large neither. But after we had made many trials, in the above mentioned glaſs, there happened a phenomenon, which gave me ſome ſuſpicion, that it was not then actually ſealed; tho' it did not appear, but that it had been very well ſealed at firſt, and might continue ſo during ſeveral tryals: for after this ſuſpicion, we uſed the glaſs ten or twelve times, or, perhaps, oftner, to make the recited experiment; and after all thoſe, we could perceive no crack or flaw in the ball or ſtem of the glaſs; and found it difficult to get in the point of a ſmall pin into a little hole, which we either found, or, by endeavouring to find, made at the apex. However, by the things formerly related, it appeared, that our noctilucal matter would burn with leſs vent, by great odds, than other fewel known to us; and that a ſmall quantity may be made to burn and ſhine longer than one would expect. And we were encouraged by what we ſaw, to hope, that if a more conſiderable quantity of matter were put into a conveniently ſhaped glaſs, and aſſiſted with other friendly circumſtances, eſpecially if the luminouſneſs could be a little heightened, it might be rendred uſeful in ſhips, and magazines of powder.

I muſt not omit, that ſometimes there appeared a little liquor in this glaſs, and that the reſt of the matter, by the repeated operations of the fire, was turned to a red colour, which it yet retains.

In water. 55. I put two grains of our icy noctiluca into a ſmall glaſs-egg, and pour'd a pretty quantity of water on it: we heated the liquor well, yet without making it boil, and thereby melted the little fragments of ſolid matter, and made them flow into one liquid maſs, that kept it ſelf at the bottom, diſtinct from the water. This done, we preſently removed the glaſs into a dark place, and pouring out the water, we obſerv'd, that as ſoon as the air came to touch the noctilucal matter, it ſeemed to be kindled into an actual flame, that afforded a very vivid light; which ſhews, that a kind of fire may be kept under water, as long as one pleaſes, without ſenſibly burning; and yet in a moment, upon the bare removal of the water; manifeſt it ſelf in the form of actual fire. That our ſhining ſubſtance was of this nature appeared evident, becauſe the water, being poured out ſomewhat too haſtily, carried along with it, which I did not intend it ſhould, the whole maſs of the noctilucal

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NAT. HIST. we obſerved no other change, than that, upon the removal of the water, and the contact of the air, the noctiluca would immediately ſhine, and continue to do ſo, till we thought fit to extinguiſh it, by pouring water on it again.

This being done in the morning, I conſidered on the following night, that the receiver having been kept in the laboratory, which being a very warm place, 'twas but fit, in order to make the trial a fair one, to bring the ſhining matter to as great a warmth, as it had in the laboratory, where it exhibited the phenomenon I was deſirous to ſee. Having, then, cauſed the receiver, with the water in it, to be held in a hot place, till the liquor had attained a fit degree of warmth, we poured out the water; and within a minute or two after, had the pleaſure to ſee, that the conſiſtent matter, notwithſtanding the wetneſs that, in probability, the water had left on it, did, upon contact with the air, take fire of it ſelf, not without noiſe, and burn with a manifeſt and actual flame. But before we could pour in water to quench the fire, the violence of the flame had broke the receiver, which was thick; and thrown off a piece above half as broad as the palm of one's hand; by which unlucky accident we were hindred from endeavouring to try, whether we could, by repeated experiments, diſcover the cauſe of the appearing contingency of this odd phenomenon.

The way of preparing the aerial noctiluca.

At length we come to give the method of preparing our noctiluca.

But, 1. I will not poſitively affirm, that the matter I employed is the very ſame that was made uſe of by the ingenious *German* chymiſts in their noctiluca; for ſome inquiſitive men have told me, that the *Germans* mix two or more diſtillable materials; whereas I employed but one ſubſtance capable of diſtillation. 2. Tho' the foregoing obſervations were commonly made upon that ſubſtance, which, I gueſs, to be, at leaſt, the chief employed by the *Germans*; yet I firſt thought, and upon my firſt trial found, that 'tis poſſible to make a noctiluca of a dry and pulverable ſubſtance, which, for ought I can gueſs, was never employed by Mr. *Krafft*, or thoſe from whom he had his ſecret. And beſides this ſecond ſort of phoſphorus, we made a third, which was obtained from a material, that never had been either a part, or an excrement of a human body; nor was mixed with any thing that had been ſo. 3. To name the matter, tho' ever ſo explicitly, wou'd not, in my opinion, have ſufficed to inform thoſe who wou'd work upon it; for chymiſts themſelves would, in all probability, work, as hitherto, on other occaſions, they have done, upon the volatile and ſaline, which they preſume to be the only ſpirituous and noble parts of the concrete: throwing away the reſt as uſeleſs and abominable. 4. I think fit to give notice, that having employed the material of our noctiluca, with-

without previous fermentation or putrefaction, tho' it was proceeded with after the ſame manner, with that whereby we obtained our ſhining ſubſtance; and tho' it afforded a ſubſtance, for colour and conſiſtence not unlike our luciferous matter; yet I could not find that it would ſhine at all. And, indeed, there are ſo many ciacumſtances that may make the experiment miſcarry, that he who ſhall, at the firſt attempt, ſucceed in preparing this liquor, muſt be a very ſkilful, or a very lucky operator. Laſtly, that it may appear, as well by the very different preparations, as by the different phenomena of the *Phoſphorus hermeticus*, and of the aerial noctiluca, that there is a great diſparity between thoſe lucid bodies; I ſhall here add the way we employed to make either the *Phoſphorus Balduini*, or ſome other like it, as it was practiſed in my furnaces. A diſſolution being made of fine white chalk in good ſpirit of nitre, or clean *Aqua fortis*, it is to be filtred thro' cap-paper; and the clear ſolution to be evaporated, till there remains a dry ſubſtance; with this white calx you are to overlay the inſide of ſome veſſel, made of good earth, that will endure the fire, and of a round figure, which is more convenient than that of ordinary crucibles; and to the matter contained in this veſſel, you are to give, for about half an hour, or an hour, according to the largeneſs of it, and other circumſtances, a due degree of fire, which 'tis not eaſy to hit, and which ordinarily requires a conveniently ſhaped veſſel, whereby the flame or heat may be reverberated, till you perceive the matter to have acquired a diſpoſition to retain the light; and then the earthen veſſel, which uſually ought to be ſomewhat ſhallow, and not to exceed many inches in diameter, is to have a cover of fine glaſs or cryſtal, carefully cemented on it, to preſerve it from its great enemy, the air.

And the PHOSPHORUS BALDUINI.

We took a large quantity of human urine, that had been for a competent time digeſted or putrefied. This we diſtilled with a moderate heat, till the ſpirituous parts were drawn off; after which, the ſuperfluous moiſture alſo was evaporated, till the remaining ſubſtance became of the conſiſtence of a thick ſyrup, or a thin extract; and this being well incorporated with about thrice its weight of fine white ſand, the mixture was put into a ſtrong retort; whereto we joined a large receiver, in great part filled with water. Then, the two veſſels being carefully luted together, a naked fire was gradually adminiſter'd for five or ſix hours; that all, which was either phlegmatic, or otherwiſe volatile, might come over firſt. When this was done, the fire was increaſed; and at length, for five or ſix hours, made as ſtrong and intenſe, as the furnace, a good one, was capable of giving. By this means there came over plenty of white fumes, almoſt like thoſe that appear in the diſtillation of oil of vitriol; and when theſe fumes were paſt, and the receiver grew clear, they were after a while ſucceeded by another ſort, which ſeemed

The proceſs for preparing the aerial noctiluca.

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in the receiver to give a faint, bluiſh light, almoſt like that of little burning matches dipped in ſulphur. And laſt of all, the fire being very vehement, there paſſed over another ſubſtance, that was judged more ponderous than the former, becauſe much of it fell through the water to the bottom of the receiver; whence being taken, it appeared, by ſeveral effects, and other phenomena, to be of a lucid nature *.

Experiments about exploſions, With the ſpirits of nitre, and of wine.

I ſhall here, for the relation of the ſubject, add a few experiments, made to ſhew the nature of exploſions.

Having put one ounce of ſpirit of nitre, ſo ſtrong, that its fumes made the upper part of the containing glaſs always reddiſh, into a bolt-head, with a long neck, able to contain twelve or ſixteen times as much; we cauſed an equal weight of highly rectified ſpirit of wine to be taken; and a little of it being put to the ſpirit of nitre, it preſently made ſo ſtrong and quick an exploſion, that ſome of

* Dr. *Wall* tells us, that Mr. *Boyle* finding, that urine yielded but a very ſmall quantity of phoſphorus, importuned him to look out for ſome other ſubject, that might afford it in greater plenty; upon which he cauſed, in the ſummer-time, a piece of dry matter to be dug up in the fields, where night-men emptied their veſſels; and breaking it in the dark, a great number of ſmall particles of phoſphorus appeared therein. This matter the Dr. immediately carried to Mr. *Boyle*, and Mr. *Eilgar*, the chymiſt, went preſently to work up by Mr *Boyle*'s direction; but could make very little or no phoſphorus from it, till another material was added thereto in diſtillation: and then he made it in ſuch plenty, that ſelling large quantities at ſix guineas, or ſix *Louis d'Ors*, the ounce; he ſoon became rich, and left *England*. *Philoſ. Tranſ.* N°. 314. p. 69.

'Tis very remarkable, what pains and coſt the judicious Mr. *Homberg*, beſtowed upon human excrement, in order to diſtil from it a fine, clear, limpid oil, without any ill ſcent; by means whereof, he hoped to fix common mercury into pure ſilver. After many laborious proceſſes, he, at length, obtained ſuch an oil; but it failed in fixing the mercury. This, however, led him to diſcover an excellent phoſphorus, which yields its light without any friction, application of heat, or mixture with any other body; and that as well by night, as by day. This phoſphorus is a powder made from equal parts of human dung, and roch-alum, mixed together, dry'd and prepared by a particular proceſs, which the author deſcribes at large. The colour of it is black, brown, red, green, yellow, or white, according to the veſſel, and the degree of fire uſed in the preparation. It begins to flame as ſoon as ever it is expoſed to the air, and ſets fire to any cumbuſtible matter whereon 'tis laid; and muſt, therefore, be kept in the ſame glaſs wherein 'tis made; for to put it out of one veſſel into another, or return any parcel of it back into the ſame, wou'd ſet it all on fire. See the *French Memoirs*, A. 1711. p. 49—59. and 307—316.

The ſame author prepared three ſorts of phoſphorus; one that would ſet combuſtible materials on fire, without appearing it ſelf in flame; another, which gives fire and flame like a burning coal; and a third, which would burn and flame like a lighted taper; and theſe only differ'd according to the degree of fire, and the quantity of alum employed in their reſpective preparations. The ſun's rays, or the moiſture of the air, gradually admitted into this powder, would ſpoil it; and it muſt, therefore, be kept in a dry, dark place. M. *Lemery* having ſucceſſively ſubſtituted ſeveral materials for the human dung, employed in this preparation, found that almoſt any animal, or vegetable material, would ſerve in its ſtead; as the yolks of eggs, wheat-flour, &c. with different proportions of alum. See *Memoir. de l'Acad.* A 1714. p. 520.

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NAT. HIST. falling ſlowly upon the ſal-armoniac, ſhou'd, without cauſing any heat, produce an exploſion not dangerous to the by-ſtanders. But in my abſence the operator, not ſtaying for particular directions, raſhly inverted the inſtrument, without taking care to get away; whence it happened, that as ſoon as ever the contain'd liquor, being too plentifully poured out, came to work on the ſal-armoniac, wherewith it uſually produces cold, there enſued an expanſion or exploſion, ſo ſurprizingly great, that with a vehement noiſe the glaſſes were broken into a multitude of pieces, and much of the mixture thrown up, with violence, againſt the operator, whereby his hat was ſtruck off, and his face, eſpecially about his eyes, much hurt; whence, immediately, tumors, extremely painful, were produc'd; which might, alſo, have been very dangerous, had I not directly cauſed the parts affected, to be bath'd with a ſolution of *Saccharum Saturni* in fair water; by which means, within an hour or two, the pain that had been ſo raging, was taken away, and the fretting oil kept from ſo much as breaking the ſkin of the tumors that it had rais'd. At another time we made a like tryal in a ſafer way, by tying a bladder ſo to the top of a bolt-head, into which we had, beforehand, put the ſal-armoniac, that by warily moving the bladder, whence the air had been preſſed, we cou'd make ſome of the ſal-armoniac, we had lodged in its folds, to fall upon the liquor, with which it preſently made an exploſive mixture that quickly blew up the bladder *.

* It may appear ſurprizing, that two cold liquors being put together ſhould immediately flame, or ſet fire to gun-powder; yet any acid ſpirit highly rectified, being mix'd with the eſſential oil of an aromatic plant, well freed from acid, and thereby render'd partly ſulphureous, will do this. But, as Mr. *Homberg* obſerves, the oils of *European* plants will not ſerve for the experiment, but it requires thoſe of hotter climates, *viz.* oil of cinnamon, cloves, mace, *&c.* Nay, if even theſe be adulterated with the other, or any way ſophiſticated, 'twill fruſtrate the tryal; which may, therefore, prove a criterion, whereby to examine them. *Memoir de l'Acad. A.* 1701. *p.* 1724.

Dr. *Slare* furniſhes us with many curious experiments relating to this ſubject. See *Philoſ. Collect. N°.* 3. *p.* 48. *Philoſ. Tranſ. N°.* 150. *p.* 291. *N°.* 213. *p.* 200.

But let us hear Sir *Iſaac Newton* upon this ſubject. "When oil of vitriol, (ſays he) "is drawn off from its weight of nitre, and "from both ingredients, a compound ſpi- "rit of nitre is diſtill'd, and two parts of "this ſpirit are poured upon one part of oil "of cloves, or caraway-ſeeds, or of any pon- "derous oil of vegetable or animal ſubſtan- "ces, or oil of turpentine, thickened with "a little balſam of ſulphur, and the liquors "grow ſo very hot in mixing, as preſently "to ſend up a burning flame; does not this "very great and ſudden heat argue, that "the two liquors mix with violence, and "that their parts in mixing, run towards one "another with an accelerated motion, and "claſh with the greateſt force? And is it "not for the ſame reaſon, that well rectified "ſpirit of wine, poured on the ſame com- "pound ſpirit, flaſhes; and that the *Pulvis* "*fulminans*, compoſed of ſulphur, nitre, "and ſalt of tartar, goes off with a more "ſudden and violent exploſion than gun- "powder; the acid ſpirits of the ſulphur "and nitre ruſhing towards one another, and "towards the ſalt of tartar, with ſo great a "violence, as by the ſhock to turn the "whole, at once, into vapour and flame? — "When a dram of the compound ſpirit of "nitre was poured upon half a dram of oil "of caraway ſeeds *in vacuo*, the mixture "immediately made a flaſh like gun-pow- "der, and burſt the exhauſted receiver, a "glaſs ſix inches wide and eight deep; and

"even

" even the groſs body of ſulphur powder'd,
" and with an equal weight of iron filings
" and a little water, made into paſte, acts
" upon the iron, and in five or ſix hours
" grows too hot to be touched, and emits
" a flame. And by theſe experiments, com-
" pared with the great quantity of ſulphur
" with which the earth abounds, and the
" warmth of the interior parts of the earth,
" and hot ſprings, and burning mountains,
" and with damps, mineral coruſcations,
" earth-quakes, hot ſuffocating exhalations,
" hurricanes, and ſpouts; we may learn,
" that ſulphureous ſteams abound in the
" bowels of the earth, and ferment with
" minerals, and ſometimes take fire with a
" ſudden coruſcation and exploſion; and if
" pent up in ſubterraneous caverns, burſt
" the caverns with a great ſhaking of the
" earth, as in ſpringing of a mine. And
" then the vapour generated by the explo-
" ſion, expiring thro' the pores of the earth,
" feels hot, and ſuffocates, and makes tem-
" peſts, and hurricanes, and ſometimes cau-
" ſes the land to ſlide, or the ſea to boil,
" and carries up the water thereof in drops,
" which, by their weight, fall down again
" in ſpouts. Alſo ſome ſulphureous ſteams,
" at all times when the earth is dry, aſ-
" cending into the air, ferment there with
" nitrous acids, and ſometimes taking fire,
" cauſe lightning, and thunder, and fiery
" meteors. For the air abounds with acid
" vapours, fit to promote fermentations,
" as appears by the ruſting of iron and
" copper in it, the kindling of fire by blow-
" ing, and the beating of the heart by
" means of reſpiration. Now the above
" mentioned motions are ſo great and vio-
" lent, as to ſhew, that in fermentations
" the particle of bodies, which almoſt reſt,
" are put into new motions by a very po-
" tent principles, which acts upon them on-
" ly when they approach one another, and
" cauſes them to meet and claſh with great
" violence, and grow hot with the motion,
" and daſh one another into pieces, and va-
" niſh into air, and vapour, and flame."
Newton. Optic. p. 353---355.

NAT. HIST.

EX-

EXPERIMENTS AND OBSERVATIONS UPON THE SALTNESS of the SEA.

NAT. HIST.

THE cauſe of the ſaltneſs of the ſea appears, by *Ariſtotle*'s writings, to have exerciſed the curioſity of naturaliſts before his time; ſince which, his authority has, for many ages, ſway'd the generality into his opinion; till of late, ſome learned men took the boldneſs to queſtion the common doctrine: and from that time, the controverſie has been kept on foot, and, for ought I know, will be ſo, as long as 'tis argued, on both ſides, but by dialectical arguments. I ſhall here, therefore, deliver ſome particulars about the ſaltneſs of the ſea, obtained by my own tryals, where I was able to make them; and where I was not, from the beſt relations I could procure.

The ſaltneſs of the Sea, whence?

Firſt then, *Ariſtotle* and his followers, derive the ſaltneſs of tha ſea from the aduſtion of the water by the ſun-beams; but it has not, I believe, been found, where no ſalt or ſaline body was diſſolved in, or extracted by water, expoſed to the ſun, or other heat, that any ſuch ſaltneſs is produced. There are many lakes and ponds of freſh water to be met with, even in hot countries, where they lie expoſed to the action of the ſun. And as for other heat, by diſtilling off common water in large glaſs bodies, till all the liquor came over, I found, at the bottom, not above a three thouſandth part of ſalt, among a little white earthy ſubſtance. And tho' there had been a greater quantity of ſalt, which, perhaps, may be met with in ſome waters, I ſhould not have concluded it generated out of the water by the action of the fire; becauſe I have, by ſeveral tryals, found, that in many places, common water, before ever it is expoſed to the heat of the ſun,

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Neopolitan coaſt, where they obſerved the water to ſpring up hot beneath the ſurface of the ſea; ſo that one of them, thruſting in his hand and arm ſomewhat deeper, found an offenſive degree of heat therein.

But as to the particular caſe of *Goa*, I inquired of a great traveller, and a man of letters, who having lived in that city, and the neighbouring places, gave me a pertinent account of it. He tells me, that the divers do not now think it needful, to fetch their freſh water ſo low as from the bottom of the ſea; and that by the little depth, whence he caus'd it to be taken up, he judg'd it did not come ſo much from any freſh water ſprings, riſing at the bottom of the ſea, as from a ſmall river, which, not far from thence, runs into the ſea; with ſuch a conjuncture of circumſtances, that the freſh water yet keeps it ſelf tolerably diſtinct and potable, though not very good.

I might alſo pretend to a clear experimental demonſtration of the contrary to what *Scaliger* delivers, from the teſtimony of the learned *Patricius*; who affirms, that being upon the ſea near *Candia*, he did, in the company of a *Venetian* magiſtrate, *Moccenigo*, let down a veſſel to the bottom of the ſea, where, by the help of a contrivance, it was unſtopp'd, and filled with water; which being drawn up, was found to be not freſh, but ſalt. However, I ſhall confirm the ſaltneſs of the ſea at the bottom, by ſome leſs exceptionable obſervations.

The firſt is, that of the perſon who, by the help of an engine, cou'd ſtay a conſiderable time at the bottom of the ſea; of whom I learn'd, that the water had as ſalt a taſt there as at the top.

The next obſervation I obtained by means of a great traveller into the *Eaſt* and *Weſt-Indies*, who having ſeen the famous pearl-fiſhing at *Manar*, near the great cape of *Comori*, was aſſured by the divers, that the ocean there was ſalt at the bottom. And the ſame perſon being asked about the ſaltneſs of the ſea, in a certain place under the torrid zone; which, by the relation of a traveller, I was inclin'd to think, abounded extraordinarily with ſalt; he affirmed, that not only the divers declared to him, that the ſea was there exceeding ſalt at the bottom, but brought up ſeveral hard lumps of ſalt from thence; whereof the fiſhermen and others made uſe to ſeaſon their meat, as himſelf alſo did; which yet we may aſcribe not only to the plenty of ſalt already diſſolved in the water, but to the greater indiſpoſition that ſome ſorts of ſalts have, to be diſſolved in that liquor. And laſtly, meeting with an inquſitive engineer, who had many opportunities to make obſervations in deep waters; I deſired him to take a certain copper veſſel of mine, furniſhed with two valves opening upwards, and let it down at ſea; but he told me, I might ſave my ſelf the trouble, for that with a tin veſſel, very little differing from mine, he had, near the ſtreights of *Gibraltar*, fetch'd up ſea-water from the depth

depth of about forty fathoms, and found it to be as ſalt in taſt, as the water near the ſurface. NAT. HIST.

Theſe obſervations may ſuffice to ſhew, that the ſea is ſalt at the bottom, in thoſe places where they were made; yet I thought it was not fit to acquieſce in them, but rather endeavour to ſatisfie my ſelf, by the beſt trial I could procure to be made with my copper veſſel, what ſaltneſs is to be found in the water at the bottom of our ſeas, when examined by weight, and not by taſt; and in order thereto, having delivered the above-mentioned inſtrument to the engineer, when he was going to ſea; he ſent me, together with it, two bottles of ſea-water, taken up, the one at the top, and the other at the bottom, fifteen fathoms deep. The colour and ſmell of theſe two waters were ſomewhat different; but when I examined them hydroſtatically, by weighing a roll of brimſtone firſt in one, and then in the other, I ſcarce found any ſenſible difference in their ſpecific gravities. So that if the degree of the ſaltneſs of ſea-water, may be ſafely determined by its greater or leſſer weight; then, ſo far as this ſingle experiment reaches, the ſaltneſs is equal at the top and bottom of the ſea.

That ſprings of freſh water may riſe at the bottom of the ſea.

And as to thoſe very few places, if really there have been any, where the ſea-water was found freſh at the very bottom; I think one may aſcribe the taſt of the water, to the bubbling up of ſprings of freſh water, at, or near enough to, thoſe very places. I know this has the appearance of a paradox; ſince it may ſeem altogether unlikely, that ſo ſmall a ſtream of water as can be afforded by a ſpring, ſhould be able to force its way up, againſt the reſiſtance of ſo vaſt a weight, as that of the incumbent ſea; eſpecially ſince this liquor, by reaſon of its ſaltneſs, is heavier *in ſpecie* than freſh water.

But perſons acquainted with hydroſtatics, know, it matters not how great a quantity of liquor, lies laterally higher than the lower orifice of the pipe or channel, that gives paſſage to the fluid to be impell'd up into it; provided the upper ſurface of that in the channel or pipe, have a ſufficient perpendicular height, with regard to that of the ſtagnant water; for no more of all this fluid will hinder its aſcent, than the weight of ſuch a pillar of it, as is directly incumbent thereon. So that, conſidering the channel wherein a ſpring runs into the ſea, as a long inverted ſyphon; if that part either of the neighbouring, or more diſtant ſhore, whence the ſpring or river takes its courſe, be a hill, or a rock, or any other place conſiderably higher than that part of the bottom of the ſea, at which the channel, which conveys freſh water, terminates; that liquor will iſſue out, notwithſtanding the reſiſtance of the ocean.

Illuſtrated and proved by experiment.

At once to illuſtrate and prove this paradox, I took a veſſel of a convenient depth, and a ſyphon of a proportionable length, both of them glaſs, that their tranſparency might permit us to ſee all that paſſed within them. Into the larger veſſel we put a quantity of ſea-

NAT. HIST. water, and into the longer leg of the ſyphon, which was inverted, we poured a convenient quantity of freſh water; and kept it from running out at the ſhorter leg, by ſtopping the orifice of the longer with the finger: then this ſyphon being ſo placed in the larger veſſel, that the orifice of the ſhorter leg was far beneath the ſurface of the ſalt-water; and the ſuperficies of the freſh water in the longer leg, a pretty deal higher than that of the ſurrounding ſalt-water; we unſtopped the orifice of the upper leg, whereby the water in the ſyphon tending to reduce it ſelf to an *Æquilibrium* in both legs, the water in the upper, being much higher and heavier than that in the other, by ſubſiding, drove away the water in the ſhorter leg, and made it ſpring out at the orifice thereof, in ſpite of the breadth and ſpecific gravity of the ſalt-water. And this impulſe of the freſh water upwards, laſted as long as the ſurface of that water in the longer leg, retained its due height above that of the ſurrounding ſea-water.

And to make this experiment the more viſible, I perform'd it with freſh water, tinged with brazil or log-wood; but to prevent its being objected, that thereby the ſpecific gravity of the liquor would be altered or increaſed; I afterwards choſe to make it with claret wine, which, being lighter than common water, and of a conſpicuous colour, is very convenient for the purpoſe. When placing the orifice of the ſhorter leg, at a convenient diſtance below the ſurface of the ſea-water, 'was pleaſant to obſerve, how upon the removal of the finger that ſtopp'd the orifice of the longer, the quick deſcent of the wine contained in it, impell'd the colour'd liquor in the ſhorter leg, and made it ſpring up at its orifice into the incumbent ſea-water, in the form of little red clouds, and ſometimes of very ſlender ſtreams. And as this ſhorter leg of the ſyphon was raiſed more and more towards the ſurface of the water, ſo there iſſued out more and more wine at the orifice of it; the liquor in the longer leg proportionably ſubſiding, yet continuing manifeſtly higher than the ſurface of the ſalt-water, than which it was *in ſpecie* lighter.

The true cauſe of ſaltneſs in the ſea.

The true cauſe of the ſaltneſs of the ſea, I, with the moderns, aſcribe to the ſalt that is diſſolved in it: but I take that ſaltneſs to be ſupplied, not only from rocks, and other maſſes of ſalt, which at the beginning were, or in ſome places may yet be found, either at the bottom of the ſea, or at the ſides, where the water can reach them; but alſo from the ſalt, which the rains, rivers, and other waters, diſſolve in their paſſage through many parts of the earth; and at length carry along with them into the ſea. For 'tis manifeſt, that ſeveral countries afford ſalt-ſprings, and other running waters, that at length terminate their courſe in the ſea; and I have ſometimes ſuſpected, that very frequently the earth it ſelf is impregnated with corpuſcles, or at leaſt, rudiments of common ſalt; though no

ſuch

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NAT. HIST. ſail ſome hundred of miles to a dangerous coaſt, by which means they often loſe the benefit of their trade-winds, and frequently of their voyage. And theſe are inconveniencies which might be, in good meaſure, prevented, if potable, and tolerably wholeſome water, could be obtained by diſtillation, in the midſt of the ſea it ſelf; to ſerve the ſailors till they could be ſupplied with natural freſh water. To attempt this, I took ſome *Engliſh* ſea-water, whence I was able to ſeparate betwixt a thirtieth and fortieth part of dry ſalt; and having diſtilled it in a glaſs-head and body, with a moderate fire, till a conſiderable portion of it was drawn over, we could not diſcern any ſaltneſs in it by the taſt; beſides, I found it ſpecifically lighter than ſuch water as is daily drunk by perſons of quality at *London*. I afterwards expoſed it to a more chymical examination, and did not by that find any thing of ſea-ſalt in it; tho' I have ſeveral times, by the ſame way, manifeſtly diſcovered a ſaltneſs in inland waters, that are uſed for ſweet. If I would have employed a ſtronger heat, and veſſels larger and lower, or otherwiſe better contrived for great diſtillation, I might, in a ſhorter time, have obtain'd much more diſtill'd water: but whether ſuch liquors will be altogether ſo wholſom, experience muſt determine. Yet that ſea-water, diſtill'd even in no very artificial way, may be ſo far wholeſom, as not ſoon to be ſenſibly noxious, may be gathered from the teſtimony of that famous navigator Sir *R. Hawkins*, who commanded a fleet in the *Indies*, for queen *Elizabeth*. For he, in the judicious account he gave of his voyage, wherein they were diſtreſſed, even in the admiral's ſhip, for want of freſh water, has this memorable paſſage. "Altho' our freſh water had fail'd us many days "(before we ſaw the ſhore) yet with an invention I had in my ſhip, "I eaſily drew out of the water of the ſea ſufficient quantity of freſh "water, to ſuſtain my people, with little expence of fewel; for with "four billets I ſtill'd a hogſhead of water, and therewith dreſſed meat "for the ſick, and whole. The water ſo diſtill'd we found to be "wholſom and nouriſhing."

Liquors diſtilled from ſea-water, chymically examin'd.

And becauſe the potableneſs of ſea-water may concern the healths and lives of men, I ſhall here add two or three obſervations I made upon thoſe few diſtill'd liquors, I had occaſion to draw from ſea-water. Having then, upon ſome of the diſtill'd liquor, dropt a little oil of tartar *per deliquium*, I perceiv'd no clouds at all, or precipitation to be made, tho' a ſmall proportion of that liquor being dropt into the undiſtill'd ſea-water, would preſently trouble and make it opake; and, tho' ſlowly, ſtrike down a conſiderable deal of a whitiſh ſubſtance. I found, alſo, that a very ſmall proportion of an urinous ſpirit, ſuch as that of ſal-armoniac, would produce a whitiſh and curdled ſubſtance in ſea-water, before it was expoſed to diſtillation, but not in the liquor drawn from it: which argued, that there were but few or no ſaline particles of ſea-ſalt aſcended with the water; otherwiſe theſe alcali-

zate

zate and urinous ſalts would, in all likelihood, have found them out, and had a viſible operation on them. I farther remember, that when the diſtillation was made in glaſs veſſels, with an eaſie fire; not only the firſt running, but the liquor that came over afterwards, was not perceived to be brackiſh, but good and potable. And by a hydroſtatical tryal, I found our diſtill'd ſea-water to be lighter *in ſpecie* than common conduit-water, but heavier than diſtill'd rain-water. NAT. HIST.

To return, it may be objected, that if the terreſtrial ſalts, carried by ſprings, rivers, and land-floods, into the ſea, were the cauſe of its ſaline taſt, thoſe waters themſelves muſt be made ſalt by it, before they arrive at the ſea. But this objection will not reach the ſprings and rivers of ſalt-water, that in ſeveral places, either immediately or mediately diſcharge themſelves into the ſea. However, I take it to be only a partial cauſe, that contributes to the degree of ſaltneſs obſerved in the ocean, where this imported ſalt may join it ſelf with that it finds there already, and being detained by it, contribute to the brininess of the water.

If it be urg'd, that from hence the ſea muſt increaſe in ſaltneſs, I may ſuſpend my anſwer till it appear by competent obſervation, that it does not; which, I think, we have no tryals to warrant. And if the matter of fact were certain, I think it poſſible to give a farther anſwer, and ſhew probable ways, how ſo ſmall an addition of ſalt may be diſpers'd by nature, and kept from increaſing too much.

The cauſe of the bitterneſs in ſea-water.

But the taſt of ſea-water is not ſuch a ſimple ſaline taſt, as ſpring-water would receive from *Sal gemmæ*, or ſome other pure terreſtrial ſalt diſſolved in it; but a bitteriſh one, that muſt be derived from ſome peculiar cauſe which authors commonly overlook. I am not aſſur'd by any obſervations of my own, that this receſs from a purely ſaline taſt, is likely to be of the very ſame kind, and to be equally met with, in all ſeas. The cauſe both of the bitterneſs and ſaltneſs of the ſea-water, is ſaid to be a duſt and bituminous exhalations aſcending out of the earth into the ſea. Now, that there is abundance of actual ſalt in the ſea-water, to give the ſaline taſt and weight it has, the ſalt, that the ſun, in many places, plentifully ſeparates from the ſaltleſs wateriſh parts, ſufficiently manifeſts. But as to the bitteriſh taſt, I think it no eaſie matter to give a true account of it; tho' I am apt to aſcribe it to the operation of ſome general agents upon the vaſt ocean, and to the alteration that the ſalt receives from the mixture of ſome other things, among which bitumen may be one of the principal.

But tho' in ſome places of the ſea there are conſiderable quantities of bitumen, or bituminous matter; yet I dare not derive the bitterneſs of the ſea wholly from bituminous exhalations, but in good part, at leaſt in ſome places, from the liquid and other bitumen, that is imported by ſprings and other waters into the ſea; of which we have an eminent inſtance in *Barbados* tar, according to the relation I had of it from an inquiſitive gentleman, who is one of the chief planters

NAT. HIST.

planters of the iſland, and took pleaſure to obſerve this liquid bitumen to be carried in conſiderable quantities from the rocks into the ſea: and I think it poſſible enough, that ſome of the ſprings which riſe under the ſurface of the ſea, may carry up with them bituminous matter, contributing to make the ſaltneſs of the ſea degenerate; as I have ſuſpected, that in ſome places the ſulphureous exhalations, and other effluvia from the ſubmarine parts of the earth, may, ſometimes, contribute to change the ſaline taſt of the ſea-water: for not only ſulphureous ſteams, but ſometimes actual flames, have broken through from the lower parts of the ſea to the upper; and I have ſometimes made, by art, a rude imitation of that phenomenon. Some experiments, alſo, of my own, and other inducements, have perſuaded me, that, ſometimes, ſea-ſalt does not obſcurely participate of combuſtible ſulphur. But as the taſt of the ſea-water is not in all parts of the ocean uniform, it might ſuffice to take notice in general, that this difference may, in ſome meaſure, be caus'd by adventitious bodies of ſeveral kinds; of which 'tis probable, that in different places the ſea-water variouſly partakes. And not to mention here the fragrant ſmell of violets, which has by ſeveral, and particularly by an eminent perſon, of whom I enquired about it, been obſerved, in ſome hot countries, to proceed from ſea-ſalt; I have many other reaſons to think, that it is uſually no ſimple ſalt, nor free from mixture. For by more ways than one, and particularly by cohobating it from its own Spirit, we have obtained a dry ſublimate, which ſeemed to be a compounded body.

And I have ſuſpected, that the various motion of the ſea, and its being expoſed to the action of the air and ſun, may contribute to give it a taſt other than ſaline; ſince ſea-ſalt, by being barely expos'd for many months to the air, and ſometimes, perhaps, put into a gentle agitation by a digeſtive heat, I found acquired a very different taſt from the ſimple ſolution of ſea-ſalt in common water.

It appears, alſo, by what I have learned from navigators, about the manifeſt various colours, and other qualities of the different parts of the ſea, that 'tis not every where of ſuch an uniform ſubſtance as men vulgarly imagine; and that vaſt tracts of it are imbued with ſtupendous multitudes of adventitious corpuſcles, which, by ſeveral ways, diverſifying its parts, keep it from being a ſimple ſolution of ſalt. And becauſe 'tis generally thought, that the ſea-water is, by reaſon of the ſalt it abounds with, uncapable of putrefaction; I will add, that having kept a quantity of ſea-water, which I had cauſed to be purpoſely taken up between the *Engliſh* and *French* ſhores, in a good new rundlet, a place where the ſummer ſun beat freely from, it did, in a few weeks, acquire a ſtrongly fetid ſmell. But a navigator of my acquaintance, having often ſailed in the *Indian* and *African* ſeas, told me, that being once, tho' it was in the month of *March*, becalmed, in a place, for twelve or fourteen days, the ſea, for want of motion, and by reaſon of the heat, began to ſtink; ſo that, he thinks, if the calm had continued

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Nat. Hist. count: "Off the cape, in 37 *d.* 00 *m.* ſouth latitude, I took up "ſome ſea-water, and kept it till I came to the line again; and "then compared it with the water there; filling the ſame bottle "again to the ſame height by a mark, and found it exactly of the "ſame weight."

Inquiring of an obſerving perſon, who had been at *Moſambique*, which is thought to be one of the hotteſt places in the world, whether he did not there find the ſea to be more than ordinarily ſalt? he anſwered me, that, coming thither in a great carack, when he returned from the town to the ſhip, he obſerved near two hands breadth of the veſſel riſen above the ordinary part, to which it uſed to ſink; ſo that he took notice of it to the captain, as fearing that part of the lading had been, by ſtealth, carried to ſhore: but the pilot, who had made thirteen or fourteen voyages to the *Indies*, aſſur'd him, what he had obſerved about the ſhip was uſual in that place, where the taſt diſcovered the water to be exceeding ſalt.

Nor need we ſcruple to allow, that ſome ſea-waters may be very much more impregnated with ſalt than ours; for water will naturally diſſolve, and retain a far greater proportion of ſalt, than that which is commonly met with in the ſea. A thirty-fifth, a thirtieth, or, at moſt, a twenty-fifth part of ſalt, will make water more ſaline, than it is found in many ſeas: and a friend of mine, who is maſter of a ſalt-work, informed me, that the water of his ſprings affords him a twelfth part of good white ſalt; and that another ſpring not far off, yields no leſs than an eighth part.

Experiments to diſcover the weight of ſea-water.

To come to my own experiments that I made about the gravity of ſea-water, which I order'd to be taken up, ſome at the depth of about fifteen fathoms near our ſhore, and ſome in another place of the channel between *England* and *France*.

We took a vial, with a long and ſtrait neck, and having counterpois'd it, we filled it to a certain height with common conduit-water: we noted the weight of that liquor; which being poured out, the vial was filled to the ſame height with ſea-water, taken up at the ſurface; and by the difference between the two weights, the ſea-water appeared to be about a forty-fifth part heavier than the other.

We carefully counterpois'd a piece of ſulphur in the upper ſea-water; it weigh'd ℥ *ſs.* 10 ½ *gr.* and being alſo weigh'd in ſea-water fetch'd from the bottom, it gave us the ſame weight; which ſhewed thoſe two waters to be of the ſame ſpecific gravity. We then weigh'd the ſame ſulphur in common conduit-water, and found it ℥ *ſs.* 15 ½ *gr.* By which it appeared, that the ſea-water was but about a fifty-third part heavier than this water: which is ſuch a difference from the proportion found in the former way of trial, that I could not imagine what to attribute it to; unleſs the ſea-water, by long ſtanding in a veſſel, which, though covered, was

expos'd

expos'd to the hot ſun, might both have been rarified, and have had ſome ſeparation made of its ſaline, or other heavier parts; on which account, that portion we took up for our trial, might appear lighter than elſe it would have done; or unleſs (the experiment having been made in *London*, where great and ſudden rains, and other accidents, will ſometimes viſibly vary the conſiſtence of common water;) the liquor I then employed, without examining it, might be more ponderous at that time than at another. To the latter ſuſpicion I was the more inclined; becauſe, having afterwards weighed the ſame piece of ſulphur, by help of the ſame balance, in diſtilled rain-water, I found the weight of the former liquor, to exceed that of the latter, by leſs, conſiderably, than a thirty-fifth part; which ſeemed to make it probable, that if the water, we chanced to employ, had been free from all ſaline, and other heavy particles, the difference betwixt this obſervation and the foregoing, would not have been near ſo great as it was. NAT. HIST.

Again, a pound, *averdupois*, of the upper ſea-water, was weigh'd out, and put into a head and body to be diſtilled in a digeſtive furnace *ad ſiccitatem*; and the diſtillation being leiſurely made, the bottom of the glaſs was almoſt cover'd with fair grains of ſalt, ſhot into cubical figures, and more white than we expected: in the reſt of the coagulated matter we took no notice of any determinate ſhape. The ſalt being weighed, amounted to ℥ *ſs. averdupois*, and 10 *gr.* At which rate the proportion of the ſalt to the water, will amount to near the thirtieth part; which was ſo much greater than the former ways of trial, made us expect, that, perhaps, it may be worth while to examine, whether ſuch a ſlow abſtraction as we made of the ſuperfluous water, in cloſe veſſels, may not have afforded us more ſalt than otherwiſe we ſhould have obtained.

But ſuſpecting that ſomewhat elſe might have concurr'd, to yield ſo great a proportion of ſalt; I ſuffered that which had been weigh'd, to continue a while in the ſcale, and ſoon perceived, that the ſcale began manifeſtly to preponderate; and, conſequently, that ſome of the unexpected weight of ſalt might be due to the moiſture of the air, imbibed after the ſalt was taken out of the glaſs, and laid by to be weighed. Wherefore, cauſing it to be very well heated and dried in a crucible, we found it to weigh 210 *gr.* whence the proportion of ſalt contained in the water was about a thirty-ſeventh part.

From whence this greater proportion of ſalt by diſtillation, than our other trials made us to expect, proceeded, ſeems not eaſie to determine; unleſs it be ſuppoſed, that the operation whereto the ſea-water was expoſed, made ſome great change in it; and that, though the ſalt we gained out of the ſea-water, ſeemed to be dry before we weigh'd it; yet the ſaline corpuſcles, upon concreting into cubes, ſo intercepted many ſmall particles of water between them, that they could not be driven away by a moderate warmth; and, conſe-

NAT. HIST. quently, ſuch grains of ſalt may have, upon this account, been leſs pure, and the more ponderous. And, indeed, I ſometimes make a certain artificial ſalt, which, though being diſſolv'd in water, it will ſhoot into cryſtals finely ſhaped, and ſo dry, as to be reducible into powder; yet coagulates water enough with it, to weigh as heavy again as before. And I have been aſſured by a very learned eye-witneſs, that there is a ſort of ſea-ſalt, which they bring to ſome parts of *England*, from the coaſt of *Spain*, or *Portugal*; that being here diſſolved, and reduced, by purification and filtration, to a much whiter kind, will yield, by meaſure, above two buſhels for one. But to determine with any certainty about the degrees of the ſea's ſaltneſs in general, a great number of obſervations, made in different climates, and in diſtant parts of the ocean, are neceſſary.

It might not be amiſs, that obſervations were heedfully made, to ſhew, whether in the ſame ſea, and about the ſame part of it, the water is always equally ſalt. For, though that be taken for granted, yet ſince we have no good, ancient obſervations, to eaſe the ſuſpicion, 'tis not improbable, that, at leaſt in many places, the ſaltneſs of the ſea may continually increaſe by the acceſſion of thoſe ſaline corpuſcles that are imported by ſalt-ſprings; and thoſe which rivers and land-floods from time to time rob the earth of. And it ſeems not impoſſible, that a particular part of the ſea may be ſometimes extraordinarily, and perhaps ſuddenly, impregnated with an additional ſaltneſs, from ſaline ſteams plentifully aſcending into it, by means of ſubterraneal fires. But it may prove the more difficult to diſcern this adventititious ſaltneſs, unleſs the taſt, as well as the balance, be employed about it; becauſe the ſalt that produces it, may be of ſuch a nature, as to be much lighter *in ſpecie* than common ſea-ſalt.

Though the weight of ſea-water, be as good a way as any yet employed, to determine what part of it moſt abounds in ſalt; and though it be poſſible, that in our ſea, and, perhaps, in almoſt all others, this way is not liable to any conſiderable uncertainty; yet it may ſometimes deceive us, eſpecially in very hot regions; becauſe I have obſerved, that there are volatile ſalts, which, though by reaſon of their activity, they make ſmart impreſſions on the tongue, and give the water imbued with them a ſtrong, ſaline taſt, yet add very little to its ſpecific gravity: as I have tried, by hydroſtatically examining diſtilled liquors, impregnated with volatile and urinous ſalts; ſome of which liquors I found very little heavier than common water, and, conſequently, nothing near ſo much heavier as they would have been made, if they had been brought to ſo ſharp a taſt, by having nothing but common ſea-ſalt diſſolved in them. And therefore, if in any particular place, by any other way, or from the ſteams of the earth beneath, the ſea ſhould be largely impregnated with ſuch kind of light ſalts, the ſea-water may be much more ſalt to the taſt,

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NAT. HIST.

To examine the freſhneſs of waters.

Conſidering that various metalline and mineral ſolutions, might be readily precipitated, not only by the ſpirit of ſalt, but by crude ſalt, whether dry or diſſolved in water; 'twas eaſie to imagin, that, by means of this precipitating quality of common ſalt, one might diſcover whether any particles of it lay conceal'd in a propoſed liquor.

To this end I employed ſeveral preparations; and tho' two or three of my other tryals had a tolerable ſucceſs, yet that which, at length, I pitch'd upon as the moſt certain, is the following.

I took ſome common water diſtill'd in glaſs veſſels, that it might leave its corporeal ſalt, if it had any, behind; and put into a thouſand grains of it, one grain of dry common ſalt: into a convenient quantity, two or three ſpoonfuls, for example, of this impregnated liquor, I let fall a fit proportion, for inſtance, four or five drops, of a very ſtrong and well-filtred ſolution of well-refined ſilver, diſſolved in clean *Aqua fortis*. I alſo made the tryal ſucceed with ſpirit of nitre; and herein, there immediately appeared a whitiſh cloud, that ſlowly deſcended to the bottom, and ſettled there in a white precipitate.

This experiment being ſeveral times repeated, was conſtant to ſucceſs, having recommended it to me for between twenty and thirty years; tho' I make choice hereof without denying, that men of ſagacity, eſpecially if well vers'd in chymical operations, may, upon the ſame foundation, find ſome other cheaper way, tho' ſcarce any more nice and certain, of compaſſing the ſame end.

But to make the experiment rigorouſly, we uſually took ſomewhat more than a thouſand parts of water to one of ſalt. And having let fall a few drops of our metalline ſolution, into a liquor obtained by a particular way of edulcorating ſea-water, there did not preſently enſue any white cloud or precipitate, much leſs ſuch an one as was afforded by the water, impregnated with leſs than a thouſandth part of ſalt. And if, after ſome time, there happen'd to appear a little cloudineſs in this factitious liquor, it was both ſlowlier produc'd, and much leſs than that which appear'd in the impregnated water.

Various ſolutions of mineral bodies may, alſo, be precipitated by dilution; that is, when the ſolution has time enough allow'd to diffuſe it ſelf, through a great quantity of water, the ſaline parts are thereby ſo attenuated and weaken'd, that they remain no longer able to ſuſtain the mineral corpuſcles, they kept afloat before; but make with them and the water, a confus'd ſubſiding mixture, uſually of a whitiſh co-

continual increaſe hereof, at length, diſcover the age of the world. The Doctor wiſhes the ſame thing had been done 2000 years ago, that we might have been at ſome certainty in this affair. For as the rivers, according to his hypotheſis, gradually waſh away the ſalt of the earth, and depoſit it in the main ocean, this muſt continually become more ſaline thereby; whence, two experiments made at large, but equal diſtances of time, might, by the rule of proportion, tell us how long the ſea has been in acquiring its preſent degree of ſaltneſs. See *Philoſoph. Tranſact.* N° 344. *p.* 296.

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ſour. This appears when the butter of antimony, being put into common water, is thereby quickly and plentifully precipitated in the form of that white powder, the chymiſts call *Mercurius vitæ*. I have alſo produc'd a powder of that colour, by pouring into common water a ſtrong ſolution of tin-glaſs made in *Aqua fortis*: and by the ſame way have precipitated the tincture of jalap, benjamin, labdanum, antimonial ſulphur, and of other bodies, made in vinous ſpirits. Were it not for this power, that water has to weaken moſt ſolutions of bodies, I could have employ'd, inſtead of ſilver, either quick-ſilver diſſolv'd in *Aqua fortis*, or lead, crude or calcin'd, in the ſame liquor, or rather in ſtrong ſpirit of vinegar; ſince theſe, and ſome others, are found precipitable by ſalt-water into whitiſh powders. But tho' a very careful obſerver may make uſe of theſe metalline ſolutions, to gueſs at the quality of water, as to freſhneſs and ſaltneſs; yet the precipitation made by dilution, is not difficult to be diſtinguiſh'd from that which is perform'd by a true and proper precipitant, both by the quickneſs of the effect, and the copiouſneſs of the white ſubſtance produc'd; being on both theſe accounts very much inferior to it: as may evidently appear in the very different effects that our particular ſolution has upon the ſea-water, peculiarly edulcorated, and upon well diſtill'd common water, compar'd with thoſe it had upon water impregnated with a thouſandth part of ſalt, and upon ſeveral common undiſtill'd waters.

To proceed; the uſefulneſs of this experiment is not to be eſtimated barely by the eſſay it helps us to make of dulcify'd waters, but much more by the eſtimate, that by its means may be made of natural freſh waters, whether of ſprings, rivers, lakes, wells, *&c.* For it being generally granted, that thoſe waters, *cæteris paribus*, are the beſt, as well for wholeſomneſs, as other various œconomical uſes, *&c.* that are freeſt from ſaltneſs; which is an adventitious, and in moſt caſes, a hurtful quality in waters; by our way of examining theſe liquors, a heedful eye may in a trice diſcover, whether there be any latent ſaltneſs in them, and enable us, eſpecially by the help of a little practice, to give a near gueſs, how much one water is freſher than another; as I have purpoſely try'd in different waters, that were ordinarily drunk by conſiderable perſons. And if once you have attentively mark'd what change four or five drops, for inſtance, of our liquor, will make in two or three ſpoonfuls, or half ounces of water; 'twill not be difficult for a heedful obſerver, keeping the ſame proportion between the two liquors, to make a near eſtimate, whether any natural water propos'd have a greater, an equal, or a leſs degree of freſhneſs or ſaltneſs, than that he has choſe for a ſtandard; and how much, in caſe there be a difference, the propos'd liquor is more or leſs free from ſaltneſs than the other.

And that ſuch a difference in a liquor of ſuch frequent internal uſe as water, may have conſiderable effects upon human bodies, in-

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NAT. HIST. reſpect of health, may be, probably, argued from the differing effects waters, more or leſs impregnated with ſalt, have upon ſeveral other bodies. Moſt pump-waters, for inſtance, will not boil peaſe and beef, *&c.* near ſo well as ſpring or rain-water, which is uſually ſofter, and more free from the ſaltneſs we ſpeak of. 'Tis commonly known, that the ſame pump-water will not ſo well and uniformly, or without curdling, diſſolve waſh-balls and ſoap, as rain-water, and ſome running waters: nay, it has been confeſs'd by ſkilful artiſts, that ſome tools, as gravers, *&c.* made of the hardeſt ſteel, would receive a different temper if quench'd in pump-water, from that which the like extinction in ſpring or river water, would give them.

And as many medicinal waters, that are preſum'd to owe their virtues to the participation either of metalline or mineral bodies, appear, upon tryal, to leave ſometimes little, and ſometimes nothing behind them, except a kind of common ſalt; our precipitant may greatly aſſiſt us to diſcover, whether a mineral water propos'd contain ſuch a ſalt; and if it do, whether copiouſly or no. This I have tried upon more than one of our *Engliſh* mineral waters, and thereby found immediately, that one reputed of another nature, contained pretty ſtore of ſaline matter; and that another is impregnated with a ſurprizing plenty of a ſaltiſh ſubſtance.

Tho', for certain reaſons, I aſcribe not to our method of examining waters, an ability to diſcover leſs than one part of ſalt in a thouſand parts of water; yet if it were requiſite, we might make more nice diſcoveries. For having, ſometimes, by means of it, put one grain of ſalt into fifteen hundred of diſtilled water, we could manifeſtly make it appear, that even this liquor, tho' ſo lightly impregnated, was not deſtitute of ſalt, but contained more of it than ſome of the peculiarly edulcorated water: nay, I once found, that a grain of dry ſalt, being diſperſed through two thouſand, and at another time that being diſſolved in three thouſand times its weight of the ſame kind of liquor, ſo inconſiderable a portion of ſalt was plainly diſcoverable by our precipitant.

But it may be objected, that as the experiments hitherto mentioned have been made only upon waters impregnated with groſs or corporeal ſea-ſalt; they may, nevertheleſs, be imbued with the ſpirit of that ſalt, which, by reaſon of its activity, ſhall prove as unhealthful to the drinker, as the groſſer ſalt it ſelf. To this I might anſwer, that a very ſmall proportion of ſpirit of ſalt, may, in many caſes, make the water ſeaſon'd with it, rather medicinal, than unwholeſom; but to manifeſt the foundation of the objection to be falſe, I took above a thouſand grains of diſtill'd water, and, inſtead of corporeal ſalt, put to it one ſingle drop of moderately ſtrong ſpirit of ſalt; and having ſhook it into the water, I let fall into a portion of this unequally compos'd mixture, ſome drops of our ſolution of ſilver, which preſently began to precipitate in a whitiſh form; ſo that, for ought appeared to the eye, this tryal ſucceeded better than if the water had been impregnated with

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DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

THE TEMPERATURE OF THE Subterranean and ſubmarine Regions.

As to Heat and Cold.

SECT. I.

NAT. HIST. *Different regions, below the ſurface of the earth.*

A Chymiſt, who purpoſely travelled to viſit *Hungary*, and other places famous for mines, aſſured me, that upon his deſcent into a mine of an exceeding great depth, he felt the air yet warm near the orifice of the groove; but afterwards deſcending towards the lower parts, he perceived it cold, till he came to ſuch a depth as he ſcarce attained by deſcending for a quarter of an hour; and that the cold he felt during this time ſeemed conſiderable, eſpecially when he was got pretty low down; that after he had paſs'd this cold region, he began, by degrees, to come into a warmer; which increaſed in heat as he went deeper; ſo that in the lower veins he found the workmen digging, with only a ſlight garment upon them: and the ſubterraneal heat, he ſaid, was much greater than that of the free air on the top of the groove, tho' it were then ſummer.

This account of a cold region in the earth, has been ſince confirmed to me by a phyſician, from an obſervation made in another *Hungarian* mine, not of gold, but copper; and of a much leſs depth than the former. For in going down, he declared he felt a conſiderable degree of cold, and the like in his return upwards; that he began to feel the cold, when he could receive no more light by the mouth of the groove; and that this cold region laſted till he came near the bottom, which was eſtimated to be about 100 fathoms in a ſtrait line from the top.

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This relation agrees very well with that of *Morinus*, who viſited the deep *Hungarian* mines in the month of *July*, and takes notice, that when he came down to the burrows, as he calls them, he did not find any heat, as at the mouth of the groove, but the beginning of a very cold, and conſiderable thick region. He further informs us, that when they had deſcended about 80 fathoms beneath the ſurface of the earth, he began to feel a breath of an almoſt lukewarm air; which increaſed as he deſcended lower: and adds, that the overſeer of the mine, who conducted him, affirmed, as did alſo the officers of other *Hungarian* mines, that in all their deep ones, after a thick tract of cold earth, there ſucceeds a lower region, which is always hot; and that after they arrived at ſuch a depth, they felt no more cold, how deep ſoever they dug. Nat. Hist.

There ſeem, therefore, to be three kinds of ſubterraneal regions, each of which deſerves a particular conſideration.

What we have to offer upon each may be thrown into the following propoſitions.

PROP. I.

The firſt region of the earth is very variable, both as to bounds and temperature.

For, the manifeſt operation of the ſun-beams, is *cæteris paribus*, greater, and reaches farther in hot climates, than in cold ones; in the midſt of ſummer, than in the depth of winter. Beſides, in ſome places, the different ſolidity, or poroſity of the earth, as alſo the nature of ſome ſalts, marcaſites, and other bodies contained in it, may differently diſpoſe the ſoil to cold or heat. And in the firſt region, the air is uſually more temperate, than that above the ſurface of the earth; nor is this region conſiderably deep.

That in the upper region of the earth, it ſhould be leſs cold than above the ſurface, ſeems reaſonable; becauſe the ſubterraneal cavities are ſhelter'd by the thickneſs of the ſides, from the direct action of the ſun-beams, the wind, *&c.* and is alſo kept from an immediate, or full contact with the external air, when that is vehemently either heated or cool'd.

That the heat of the ſun much leſs powerfully affects ſuch places, as are ſhelter'd from its action by ſolid bodies, appears by the repoſitories of ice or ſnow, wherein 'tis kept during all the heat of ſummer; and that, oftentimes in cavities which are at no conſiderable depth beneath the ſuperficies of the earth. Nay, having had occaſion to keep ice for many weeks, after the froſty weather was gone, I did it, without either digging to a conſiderable depth in the ground, or building any ſubſtantial ſtructure over the cavity.

And a gentleman told me, that in the ſouthern part of *France*, where the heat ſeem'd to exceed that of ſeveral parts of *Italy*, ſome curious perſons, who reſolved to have ice in ſummer at any rate, tho' they could not dig four feet into the ground without meeting

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with water, they were yet able to make reſervatories, by covering a brick building, that ſtood over their pits, with clay and ſand, to a very conſiderable thickneſs; and taking care, that the only place which ſhould admit acceſs to the outward air, was a ſmall northern door, fitted exactly cloſe, and fenced with a little porch, furniſhed with another door. And by this means, he affirms, theſe gentlemen preſerv'd the ſame included ice, ſometimes for two or three years together.

And even where the intercourſe is not debarr'd betwixt the ſubterraneal and the ſuperior air, the operation of the ſun-beams may be very much leſs in a ſhallow cavity beneath the ſurface of the ground, than above it. For trials have informed me, that liquors, differing in little elſe than in conſiſtence, will not ſo eaſily pervade each other, as a man would imagine; unleſs ſome external motion promote their intimate mixture.

Deſcending, late in the morning, into a pit, where they were digging out iron-ore, tho' this cavity had no very narrow orifice, and was dug directly downwards, and exceeded not ten or twelve feet in depth; yet I found the heat no way troubleſom, while I ſtayed there, tho' the pit were in an open field, unſhaded by trees; and tho' the air abroad, were much heated at that time of the year, which was in the dog-days.

And as the ſubterraneal air, even in the firſt region, is uſually much leſs heated than that above the earth; ſo the lower air is, *cæteris paribus*, much leſs refrigerated, by the grand efficients of cold, than the upper. For the ſubterraneal air, being, tho' comparatively, cool, yet indeed moderately warm in ſummer, ought not to be affected with the winter's cold, ſo much as that contiguous to the ſurface of the earth; from whoſe immediate contact it is defended by a thick arch: and that the cold reigns moſt in the free air, and the ſuperficial parts of the terreſtrial globe, appears, becauſe water begins to freeze at the top, not at the bottom. And, we ſee, that in cellars arched, and carefully kept cloſe from the communication of the outward air, beer, and other liquors, may be kept from freezing in froſty and ſnowy weather; as I have obſerved in a ſhallow cellar, but well arch'd, during a ſevere winter; which froze ſtronger liquors than beer, in another adjoining cellar, that differ'd not much from it in depth, but had not ſo thick and ſolid a roof. And even in *Ruſſia* it ſelf, where the cold is extreme, it reaches not near ſo deep as one would expect.

PROP. II.

The ſecond region of the earth ſeems to be generally cold, in compariſon of the other two.

It ſeems reaſonable, ſince the earth is naturally a body conſiſting of groſs and heavy parts, uſually much leſs agitated than thoſe of our organs of feeling, that it ſhould, as to ſenſe, be cold; and therefore that quality may be juſtly aſcribed to it, in a region, where, by its

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then ſuppoſe, that in ſome places of the latter, there is a mine of that earth, naturally abounding with embryonated nitre, or other ſalt, that is apt to ſend our refrigerating effluvia, or by its contact to cool the air. Let us alſo ſuppoſe, that by the ſides of another well of the ſame depth, there are numerous unripe minerals, in the proceſs of generation, or rather, a great quantity of marcaſitical earth, yet of ſo open and looſe a texture, that not only water, but air alſo, wou'd, in a few hours, evidently work upon it. And ſince, whilſt marcaſites ſlowly diſſolve, it has been obſerved, that many of them will conceive a conſiderable degree of heat; 'tis very probable, that the temperature of the earth, in the place abounding with theſe marcaſitical minerals, will be very warm, in compariſon of the temperature of the other place, where the ſoil plentifully produces nitrous and other refrigerating bodies; tho' both the places be ſuppos'd at the ſame diſtance from the ſurface of the earth, and conſequently in the ſame ſubterraneal region.

Upon the like grounds it may alſo be ſuſpected, that in the ſame place the temperature will not be always the ſame; even upon account of the ſoil. For ſome ſaline earths, that partake of the nature of marcaſites, admit a kind of gradual maturation, and perhaps other changes which ſeem ſpontaneous; and ſuch changes may happen the more remarkably in thoſe parts of ſuch bodies as are expoſed to the air, which are the parts placed at the ſides of the deep wells we are talking of.

Hence a mineral, to which either heat or cold is to be referr'd, may be more plentiful, ripe, and operative, at one time than at another; or, at length, all the earth capable of being aſſimilated by the mineral rudiments harbour'd in it, may be conſumed; or the mineral it ſelf arrive at a perfection of maturity, which will render its texture cloſe, and unfit to be penetrated, and wrought upon, as before, by the water, or other liquor, which occaſion'd its heat.

PROP. IV.

The third region of the earth has been obſerved to be conſtantly and ſenſibly, but not uniformly warm; being in ſome places conſiderably hot.

Almoſt all the deep grooves that mineraliſts have given us accounts of, and wherein men have wrought long enough, to take ſufficient notice of the temperature of the air, have been made in ſoils furniſhed with metalline ores, or other minerals, without which, men would not be at the charge of ſinking ſo very deep into, and maintaining workmen in them; ſo that experience has yet but ſlenderly, or, at leaſt, not ſufficiently informed us of the temperature of thoſe parts of the third region of the earth, that are not furniſh'd with ponderous minerals; and conſequently it has not informed us of the temperature of the lower region in general.

Having purpoſely inquired of ſeveral perſons, who had viſited and frequented the third region of the earth, in different countries and ſoils,

and

and at different depths and ſeaſons of the year, I did not perceive that any of them had ever found it ſenſibly cold. And ſuſpecting, that, in ſome caſes, the narrowneſs of the cavities, wherein the diggers were reduced to work, might make the warmth, they felt, proceed, in great part, from the ſteams of their own bodies, and, perhaps of the minerals, and from the difficulty of cooling the blood in the air clogg'd with effluvia; I inquired, whether the heat of the ſubterraneal air, in ſuch places, might not be referr'd to the like cauſes. But I was anſwered in the negative, particularly by an inquiſitive perſon, who had been in the deepeſt and hotteſt mines that have been viſited by any acquaintance of mine. NAT. HIST.

There are ſtill, I think, two principal cauſes to which we may, probably, refer the temperature of thoſe places where the air is but moderately warm.

And firſt, the coldneſs of winter may not be felt in the lower region of the earth; becauſe the air there is too remote from that above the earth, to be much affected with thoſe adventitious cauſes of cold, which make that quality intenſe in the open air. But poſſibly the poſitive cauſe of the actual warmth there, may proceed from thoſe deeper parts of the ſubterraneal region, which lie beneath the places where men have yet had occaſion to dig. For it ſeems probable, that, in theſe yet unpenetrated bowels of the earth, there are great ſtore-houſes, either of actual fires, or places conſiderably hot, or in ſome regions, of both; from which magazines of ſubterraneal heat, that quality is communicated, eſpecially by channels, clefts, *&c.* to the leſs deep parts of the earth, either by a propagation of it thro' the ſolution of the interpoſed part of the ſoil, or by a more eaſy diffuſion of the fire or its effects thro' the above-mentioned conveyances; or elſe by ſending upwards hot mineral exhalations and ſteams, which, by reaſon of the comparatively heavy materials, whereof they conſiſt, and of their being leſs diſpers'd nearer the parts from whence they proceed, are uſually more plentiful in the deeper parts of the earth, and ſomewhat affect them with the quality that they brought from the places where they were form'd.

That manifeſt ſteams are often found in grooves, eſpecially in deep ones, is evident by the damps which infeſt moſt of them; and this in diſtant regions, as ſeveral provinces of *Germany*, *Bohemia*, *Hungary*, &c. as alſo in ſeveral parts of *England*. By which it appears, that ſeveral of theſe exhalations aſcending from the entrails of the earth, are ſulphureous, bituminous, and, in ſome grooves, apt to take fire. However, the eaſie inflammability of bodies is not always a ſure proof of the actual ſenſible warmth of the minute parts they conſiſt of. For tho' ſalt-petre be very inflammable, yet being by ſolution, in fair water, reduced to inviſible corpuſcles, it highly refrigerates that liquor. Nor have I obſerved its fumes, when far from the fire, to have any heat ſenſible to the touch. And the like may be ſaid of

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the exhalations of highly rectified ſpirit of wine, which yet, we know, is it ſelf totally inflammable. Nay, large exhalations may aſcend from the lower parts of the earth, and yet be rather cold than hot. For I have made a mixture, that plentifully emitted ſteams, even whilſt its component ingredients, briſkly acting upon one another, were conſiderably cold.

But having purpoſely inquired of an obſerving man, who frequented deep mines, wherein he had a conſiderable ſhare; he aſſured me, he plainly obſerv'd the fumes that came out of the mouths of them to be actually and ſenſibly warm, and this in a warm ſeaſon of the year. And *Morinus*, ſpeaking of the deep *Hungarian* mines, tells us, the large exhalation, that aſcended from the bottom, was hot. And that at the mouth of a well, the aſcending fumes were ſenſibly hot, even in ſummer.

That alſo in many places of the earth, where no grooves are dug, and no viſible exhalations taken notice of, effluvia may yet pervade the ſoil, and exerciſe ſome operations of warmth, appears, probably, from hence; that *Agricola* reckons it, among the ſigns of a latent mineral vein, that the hoar-froſt does not lie upon that tract of the ſurface of the earth, under which a vein runs. The like directions I have known given by the ſkilful in *England*, for the diſcovery of places that contain coal-mines. And a near relation of mine ſhew'd me a great tract of his land, which, he affirmed, would not ſuffer ſnow to lie upon it for above a day or two, in the midſt of winter.

A very ingenious gentleman, alſo, who lives among mines, and is concern'd in ſome of them, aſſured me, that in ſome places which he knew to have mineral veins beneath them, he obſerv'd, neither ſnow nor ice would continue ſcarce at all upon the ſurface of the ground, even in an extraordinary cold winter. And ſome learned men tell us, that near the gold-mines in *Hungary*, the leaves of the trees are often found of a golden colour, proceeding from the metalline exhalations of the mines; which, one would think, muſt, by reaſon of their weight, require a conſiderable heat to raiſe them into the open air.

Theſe latent fires and heats in the bowels of the earth will, it may be ſaid, account for the warmth only of thoſe places that are within reach of the action of ſuch efficients, which are, probably, wanting in many parts of the earth.

But the troubleſome degree of heat, to be found in ſome places of the third region, ſeems not always to be derivable from the two cauſes already aſſigned; which muſt, to produce ſo conſiderable an effect, be aſſiſted by a third, more powerful than themſelves; and this ſeems to be the incaleſcence there is, in many mines and other places, produced by the mutual action of the componant parts of immature and more looſely contex'd minerals, promoted by water; and eſpecially ſuch as are of a marcaſitical nature.

That ſuch an incaleſcence may be thus produced in the bowels of the earth, appears by example of the like, producible in mineral bodies above

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aſſured me, that both winter and ſummer, the current of air went conſtantly the ſame way; the air entering in at the mouth of the air-ſhaft, and coming out at the perpendicular groove. And *Morinus* tells us, that in the deep *Hungarian* mines he viſited, the outward air paſs'd firſt thro' the burrows, and ſo thro' by-ways, that tended not directly downwards, but reached, at length, to the bottom of the perpendicular groove; whence, together with the ſteams, proceeding from the mine, it aſcended ſtrait upwards; without taking notice of *Agricola*'s obſervation, about the different courſe of the ſubterraneal air, at different ſeaſons of the year.

But theſe accounts are accommodated only to the few informations I have hitherto procured; and are therefore only propos'd to be rectified, or confirmed, by future obſervations.

In the mean time, we may gather from the whole, that tho' in ſome mines three ſubterraneal regions, with their diſtinguiſhing properties, are not inconveniently aſſignable; yet, generally ſpeaking, in the whole body of the terreſtrial globe, as far as we know it, both the bounds, and the temperature of the regions of the earth, as well as thoſe of the air, are very various and uncertain.

And much leſs have we any certain knowledge of the temperature of the more central parts of the earth; in which, whether there be not a continued ſolidity, or great tracts of fluid matter; and whether different regions are to be diſtinguiſh'd, and what is their number, order, thickneſs, *&c.* we are wholly ignorant.

What we have diſcuſſed, belongs only to the temper of thoſe ſubterraneal parts, to which men have been enabled to reach by digging. 'Tis true indeed, that ſome mines, eſpecially in *Germany* and *Hungary*, are of a vaſt depth; yet the deepeſt of all the mines, that I have as yet read, or heard of, from any credible relator, is that which *Agricola* mentions to be at *Cotteberg*. But what proportion does this it ſelf, tho' it reach to above 3000 feet, bear to the whole depth of the terreſtrial globe, whoſe ſemi-diameter is more than 4000 miles?

SECT. II.

The different regions below the ſurface of the ſea.

THO' the air and the earth have, as to temperature, been diſtinguiſhed into three regions; yet the informations I have hitherto met with, aſſign no more than two to the ſea: the former whereof may be ſuppoſed to reach from the ſuperficies of it, as far downwards as the manifeſt operation of the ſun-beams, or other cauſes of warmth, penetrate; from which, to the bottom of the ſea, the other region may be allowed to extend.

But

But according to this diviſion, the limits of the upper region will not be always conſtant; for the torrid zone, and other hot climates, it muſt, *cæteris paribus*, be greater than in the frigid, and the temperate zones; in ſummer than in winter; and in hot weather than in cold; ſuppoſing in theſe caſes the heat to come from the ſun and the air; and not, as ſometimes it may, from ſubterraneal exhalations. NAT. HIST.

The ſame cauſes will, likewiſe, alter the temperature of this region. This temperature may, alſo, be chang'd, in ſome few places by, at leaſt, two other cauſes; the one is, the different conſtitution of the ſoil that compoſes the ſhore; which may affect the neighbouring water, if it extraordinarily abound with nitre, marcaſites, or other ſubſtances, able to increaſe or leſſen the coldneſs of the water.

Another cauſe may be, the figure and ſituation of the leſs deep parts of the ſhore, which may, in ſome ſort, reverberate the heat that proceeds from the ſun; and upon ſuch an account, either add to the warmth, or allay the coldneſs that would otherwiſe be found in the neighbouring water. There may, indeed, be other exceptions to the rule; tho', perhaps, referable to the two caſes already mentioned. Thus M. *de Monts*, in his voyage to *New-France*, tells us, that "about "the 18th day of *June*, he found the ſea-water, during three days "ſpace, very warm; and that their wine, by the ſame heat, was "warm'd in the bottom of the ſhip; tho' the air was no hotter "than before." And, that "on the 21ſt of the ſame month, they "were, for two or three days, ſo encompaſſed with miſts and cold, "that they thought themſelves in the month of *January*; the water "of the ſea being extremely cold, which continued till they came up-"on the bank."

The temperature of the lower region of the ſea is generally cold. For water, being in its moſt ordinary ſtate, a liquor, whoſe parts are more ſlowly agitated, than thoſe of mens organs of feeling, muſt be, upon that account, cold as to ſenſe; and conſequently, thoſe parts of the ſea, which are too remote to be ſenſibly agitated by the ſun-beams, or wrought upon by the warmth, which the air, and upper parts of the earth, may from other cauſes receive, ſhould feel cold to thoſe who deſcend into it; except in a few places, where the cold may be either expell'd, or allay'd by hot ſprings, or terreſtrial exhalations, flowing, or aſcending from the ſubjacent earth, or the lower parts of the ſhore, into the incumbent, or adjacent parts of the water.

Relations about the temperature of the ſea.

I ſhall now ſubjoin ſome relations I procured, from perſons who had occaſion to go down into the lower region of the ſea; or otherwiſe to take notice of its temperature, in very different regions of the world, and at very unequal depths.

A profeſs'd diver, ſeveral times complained to me of the coldneſs of the deep water in the north ſea, which kept him from being able to ſtay in it ſo long, as he otherwiſe might. He added, that he conſtantly found the cold increaſe, the deeper he deſcended.

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An acquaintance of mine, who made a long ſtay in *North-America*, and who took pleaſure in ſwimming under water, told me, that tho' he ſcarce remember'd himſelf to have dived above two fathoms beneath the ſurface of the ſea; yet even at that ſmall depth, he obſerved the water to increaſe in coldneſs, proportionably to his deſcent: which argues, that tho' the ſun-beams often penetrate plentifully enough to carry light to a great depth under water; yet they do not always bring with them a ſenſible heat; and that, at leaſt in ſome places, the upper region of the ſea reaches but a little way.

A perſon of quality, who had been preſent at the coral-fiſhing upon the ſhore of *Africa*, and who was himſelf a diver, inform'd me, that tho' he had ſeldom deſcended above three or four fathoms, yet he found it ſo much colder than near the top of the water, that he could not well endure it; and that being let down to the bottom of the ſea in a great diving bell, tho' the water cou'd not come immediately to touch him, he found, when the bell came firſt to the ground, the air in it was very cold; tho', after he had ſtay'd a while there, his breath, and the ſteams of his body, made him very hot.

A famous commander, who had been upon the *African* coaſt, informed me, that, in the day-time, he there preſerved his wine in a tolerable temper, by keeping it at the bottom of the ſhip in ſand; but that in the mornings, he had it greatly cool'd, by ſinking his bottles over-night into the ſea, and letting them hang till morning, at twenty or thirty fathoms deep under water.

An intelligent gentleman, who ſailed far up the river *Gambra* in a ſmall frigat, aſſured me, that in the ſea, even of thoſe hot climates, wine may be preſerved cool, by letting down bottles in the evening, exactly ſtopp'd, to the depth of twelve or fourteen fathoms; whence being the next morning drawn up, they find it very freſh, if preſently drank; otherwiſe the heat of the air on the upper part of the water would quickly warm it.

I remember too, that a man of letters, who ſailed to the *Eaſt-Indies*, told me, 'twas the practice of his captain, and other perſons of note, whilſt they paſs the torrid zone, to keep their drink, whether wine, or water, cool, by letting it down in bottles to the depth of eighty, ninety, or ſometimes an hundred fathoms; and ſuffering it to ſtay there for a competent time; after which, they found it to be exceeding cool and refreſhing.

Laſtly, to ſatisfie my ſelf as far as I could, to how great a depth the coldneſs of the ſea reached; meeting with a curious traveller, who had been in ſeveral parts of the *Eaſt* and *Weſt-Indies*, I enquired of him, whether he had taken notice of any extraordinary deep ſoundings in the vaſter ſeas; to which he anſwer'd, that ſailing to the *Eaſt-Indies*, over a place on the other ſide of the line, that was ſuſpected to be very deep; they let down 400 fathom of line; and that the lead, which weigh'd about 30 or 35 pounds, thereby received

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failed in the ocean, very far from land, they ſeldom ſounded; but as far as they had, he uſually found the depth of the ſea to increaſe or decreaſe gradually, without very great irregularities, excepting in ſome places; inſtancing particularly, in the hollow that makes the bottom of the ſea within ſight of the cape of *Good-Hope*; where, tho' for the moſt part, he found the water to grow deeper as he ſailed farther from the ſhore; yet, in one place, he and others had met with a bank at a conſiderable diſtance from the ſurface of the water; ſo that tho' when they were, as they imagined, near the edge of this bank, they found but a moderate number of fathoms; yet when ſailing a very little way farther, they had gone beyond it, the ſea prov'd of an immenſe depth. In ſhort, I gather'd from his anſwers, that in the greater ſeas he had found, for the moſt part, the ground, at the bottom, to fall away by degrees; but nearer the ſhore, he obſerved, in ſeveral places, that it was very unequal, and had, as it were, hills and precipices.

A man of learning, who had ſail'd both to the eaſt and weſt *Indies*, and had made ſome of his voyages in ſhips of ſuch great burthen, as obliged the mariners to be frequent and careful in ſounding, informed me, that, ſometimes, at conſiderable diſtances from ſhore, he had obſerv'd the ſea to be twenty, thirty, or, perhaps, forty fathoms deeper when they caſt the lead from one ſide of the ſhip, than it had been juſt before, when they ſounded from the other.

In the notes of a very ſkilful pilot, lately arrived from the eaſt *Indies*, I found the following obſervations: "*Feb.* 12. Seeing the "ground under us, we heav'd the lead, and had but nineteen fathoms, "rocky ground, then hal'd by N. N. E. the wind at N. W. and found "our water to ſhoal from nineteen to ten and eight fathom, hard coral "ground; then it ſuddenly deepen'd again from eight to twenty and "twenty-two fathoms, ſandy ground; and then we ſuddenly ſaw rocks "under us, where we had but ſeven fathom, and the next caſt four-"teen fathom again. And ſo having run N. N. E. from ſix in the "morning till twelve at noon, about nineteen miles, we deepen'd our "water from ſixteen to twenty-five, and the next caſt no ground, with "thirty-five fathom of line."

Having met with an ancient navigator, who paſſes as the moſt experienc'd pilot in our nation for an *Eaſt-India* voyage, I aſk'd him about his own obſervations concerning theſe unequal ſoundings; and he told me, that he had not only met with them elſewhere; but that not far from the mouth of our channel, he had ſometimes found the bottom of the ſea ſo abrupt, that in ſailing twice the length of his ſhip, the water wou'd deepen from thirty to a hundred fathoms, if not much more.

And a noble perſon, who has, ſeveral times, had the command of the *Engliſh* fleet, informed me, that he had obſerv'd the bottom of the ſea to be exceeding unequal in neighbouring places; and that ſailing once, even in our channel, he perceiv'd the water to make a rippling noiſe, like that of the *Thames* under *London-bridge*, ſo that he was afraid

they were falling upon some shoal; the water being twelve or fourteen fathoms deep; and going a little further, he cast out the plummet again, and found it about thirty fathoms. He added, that he had made many such observations, but took notice of rippling water only when the tide was ebbing; yet in a deep sea, meeting with the like in the upper part of the water, and thinking it improbable there should be any shoal there, he order'd the depth to be sounded, and found it to exceed thirty fathoms; and after he had pass'd on a little further, the sea was so deep, that he could not fathom it with his ordinary line.

The pressure at the bottom of the sea.

Another thing observable, at the bottom of the sea, is, the great pressure of the water there against other bodies. But for a manifest proof of this, we caus'd a cylindrical glass, that was open only at one end, to be so depressed in a glass-vessel full of water, with a convenient weight of lead, that none of the air could get out; whilst we easily discern'd thro' the liquor and vessels, which were all transparent, that as the inverted cylinder descended deeper, the external water compress'd the imprison'd air, and ascended higher in the cavity of the cylinder; against whose sides we had before-hand plac'd a row of marks, whereby to take notice of the gradual ascent and descent of the internal water.

Having inquired of two several persons, one whereof had, with a diving-engine, been at the bottom of the sea in a cold northern region; the other having done the like, in an engine much of the same sort, upon the coast of *Africa*; I found their relations to agree in this, that the deeper they descended into the sea, the more the air, they carried down with them, was compressed; and the higher the water ascended above the lip or brim of the engine into the cavity of it.

And an engineer of my acquaintance, who had been often at sea, and lov'd to try conclusions, assured me, that having, several times, sailed near the streights mouth, over a place where the sea was observed to be of a notable depth, he found, that if he let down with a weight into the sea, such a vial as the sea-men use to carry their brandy in, containing a pint or a quart, it wou'd, when it came to be sunk forty fathoms under water, if not sooner, be so oppress'd, as to be crush'd to pieces. He also averr'd, that having exactly clos'd a metalline æolipile, and with a competent weight sunk it sixty fathoms into the sea; when he pull'd it up again, he found, that the great pressure of the water had, in several places, crush'd it inwards.

The tranquility of the water at great depths.

A third thing observed, at the bottom of the sea, is, the tranquility of the water, if it be considerably distant from the surface. For tho' the winds have power to produce vast waves in that upper part of the sea, which is expos'd to their violence; yet the vehement agitation diminishes, by degrees, as the parts of the sea lie more remote from the superficies; so that towards the bottom, if that lie con-

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conſiderably deep, and far from ſhore, the water is ſcarce ſenſibly diſturb'd.

This calmneſs of the ſea will appear ſtrange to many, who, admiring at the force of ſtormy winds, and the vaſtneſs of the waves they raiſe, do not, at the ſame time, conſider the almoſt incomparably greater quantity and weight of water that muſt be mov'd, to make any great commotion at the bottom of the ſea; upon which ſo great a maſs of ſalt-water is conſtantly incumbent.

But a diver, who, by the help of an engine, could continue for ſome hours under water, inform'd me, that the wind being ſtrong, ſo that the waves were manifeſtly ſix or ſeven feet high above the ſurface of the water, he found no ſign of it fifteen fathoms deep; but that if the blaſts continu'd long, they then mov'd the mud at the bottom, and made the water thick and dark; and that ſtaying once at the bottom of a deep ſea very long, he was amaz'd, at his return to the upper parts of the water, to find a ſtorm there, which he dreamt not of; having left the ſurface calm when he deſcended.

A great traveller, who had aſſiſted at a rich pearl-fiſhing in *Eaſt-India*, told me, that he had ſeen the divers deſcend when the ſea was ſo very rough, that ſcarce any veſſel would venture out of port; yet thoſe returning divers aſſured him, that, at the bottom, they had found no diſturbance of the water; and this tho' the ſituation render'd it exceeding likely to be a troubled ſea.

And a very eminent ſailor aſſured me, that having, ſometimes, been in great ſhips that drew much water, he had dived to the keel of them, when under ſail, and obſerved the agitations of the water to be exceedingly diminiſhed, even at that ſmall diſtance from the upper part of the waves; he added, that in *America* he learn'd to dive of the *Indians*, who taught him, by their example, to creep along by the rocks and great ſtones, that lay near the ſhore, at the bottom of the water, who thus ſhelter themſelves from the ſtrokes and other ill effects of the billows, which, near the ſhore, when the ſea is ſhallow, often hurt and endanger ſwimmers and unſkilful divers. But when they are, by this means, got farther from ſhore, and into deeper water, they will ſecurely leave the ſhelter they had, till then, made uſe of, and ſwim within a few yards of the ſurface of the ſea; fearing there no danger from the toſſings and commotions of the upper part of the water.

And farther, a great commander at ſea, who has both an extraordinary curioſity, and an unuſual care in making obſervations, informed me, that he had lately been at a place when the ſea was often tempeſtuous; and that they found, by a ſure mark, the ſtorm did not reach, with any efficacy, four fathoms beneath the ſurface of the water.

I have ſollicitouſly inquired, whether the tides reach to or near the bottom of the deeper ſeas; but found it exceeding difficult to obtain any ſatisfaction about a problem, that moſt navigators, I have convers'd with, ſeem not to have dream'd of.

Indeed,

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The laſt obſervable I ſhall mention is, the growth of plants at the bottom of the ſea.

Plants growing at the bottom of the ſea.

An eminent and inquiſitive perſon, who ſpent ſome time on the coaſt of *Africa*, where he was preſent at a coral-fiſhing, told me, he had found coral ſoft and flexible, but not truly red, when firſt brought up into the air; the bark being worſe coloured, than the ſubſtance it cover'd; but that when the bark was taken off, and the other part expos'd to the air, the redneſs diſclos'd it ſelf. When I demanded, whether he had obſerved any inky ſap aſcend, to nouriſh the ſtony plant; and whether he had ſeen any thing like berries upon it; he ingenuouſly confeſs'd to me, he had not been ſo curious as to make inquiry into thoſe particulars; but that having broken ſome of the large pieces, he took notice, that the more internal ſubſtance was much paler than the other, and very whitiſh; and that at the extreme parts of ſome branches, or ſprigs, he obſerved little blackiſh knobs; which he did not then know what to make of. But as to the depth of the ſea in that place, he ſaid, 'twas 9 or 10 fathoms.

And a gentleman, who ſailed much in the *Eaſt*, aſſured me, they often meet in thoſe ſeas, with a certain ſort of coral, not white, which bears a ſmall fruit like a round berry, of a pleaſant colour, and eſteem'd a rarity.

Aſking a profeſs'd diver, whether he had not found trees, or fruit, in the depth of the ſea; he told me, that in a great ſhip whereinto he deſcended, to recover thence ſome ſhip-wreck'd goods, he was ſurpriz'd to find, in ſeveral places, a certain ſort of unknown fruit, of a ſlimy and ſoft conſiſtence, about the bigneſs of apples, but not ſo round in ſhape; which, when he brought up into the air, ſoon began to ſhrink like old rotten apples; but were much harder, and more ſhrivel'd. And 'tis remarkable, that this happen'd in a cold northern ſea.

One who made a conſiderable ſtay about *Manar*, told me, he learn'd from the divers, that in ſome places thereabouts, there grows at the bottom, in plenty, a ſort of trees bearing leaves, almoſt like thoſe of laurel, as alſo a certain fruit.

I was, likewiſe, informed by an eye-witneſs, that near the coaſt of *Moſambique* in *Africa*, there grows at the bottom of the ſea, numerous trees, bearing fruit; which he deſcribes to be very like that which in *America* they call *Acayu*; the leaves alſo reſembling thoſe of that tree.

But the moſt acceptable information I could procure about ſubmarine plants, is that which concerns the famous *Maldivian*, or *Cocoa* nut, ſo highly eſteem'd in the *Eaſt*, that, as ſome write, it is a great preſent from one king to another; and is beſides greatly commended in *Europe* by phyſicians; for, the origin of this dear drug

is

is almoſt as much controverted, as its alexiterial virtues are ex- NAT. HIST.
toll'd.

A man of learning, who had reſided upon the ſpot, told me, he often heard from the divers, that there are real nuts or fruit, bore by a ſort of cocoa-trees growing at the bottom of the ſea; and that they are thence either torn off by the agitation of the water, or gather'd by the divers. This fruit is ſmaller than moſt other ſorts of cocoa's, whoſe maturity they do not ſeem to arrive at. He thinks the ſpecies may have been very different from what it is; and have come from nuts fallen into the ſea; together with the ruin of ſome little iſlands undermined by the water, and ſo drowned: of which, he told me, he ſaw three or four inſtances, during his ſtay there. He added, that whilſt the fruit was under water, they obſerved no diſtinct ſhell and kernel; but the entire nut was ſo ſoft, that it might be eaſily cut with a knife, and was eaten like their other fruits; that being kept, for about a week, in the hot air, it grows ſolid and ſo hard, as to require ſteel tools to work upon it; and laſtly, that tho' even upon the place, the fairer ſort be of very great eſteem, yet there are none of ſuch prodigious price as is given out. He preſented me with one, about the bigneſs of a large egg, and a fragment of another; which are both very hard. *

Count *Marſigli* has, from his own experience, wrote a very voluminous, phyſical eſſay, upon the natural hiſtory of the ſea; and therein occur abundance of curious particulars, relating to this ſubject: ſome ſketches whereof M. *Fontanelle* gives us in his hiſtory of the Royal Academy, for the year 1710.

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THE

PREFACE.

THE great advantages of chymiſtry, and its exceeding uſefulneſs both to philoſophy and medicine, ſeem to be very little known, or conſidered, by the generality of mankind.

For this reaſon, and becauſe Mr. Boyle *has been cenſured by ſome learned men, for cultivating an art which they apprehended to be unworthy of him, I would willingly offer ſomething, from others, towards the clearing of this matter, and wiping off an aſperſion, which, thro' a falſe notion of chymiſtry, has been caſt upon our excellent author.*

We are to obſerve, with an eminent writer, that "chymiſts "may be divided into three ranks: ſuch as look after the "knowledge of nature in general; ſuch as ſeek out and pre- "pare medicines; and ſuch as ſearch after riches, by tranſ- "mutations, and the great elixir. The two firſt, ſays that "learned prelate, have been very ſucceſsful in ſeparating, "compounding, and changing the part of things; and in ſhew- "ing the admirable powers of nature, in the raiſing of new "conſiſtencies, figures, colours, and virtues of bodies: and "from their labours, the true philoſophy is like to receive "the nobleſt improvements. But the pretenſions of the third "kind are not only to endow us with the benefits of this life, "but with immortality it ſelf; and their ſucceſs has been as "ſmall as their deſign was extravagant;—but certainly, "if they cou'd be brought to content themſelves with moderate

"*things;*

" *things; to grow rich by degrees; and not to imagin they*
" *ſhall gain the* Indies *out of every crucible; there might be*
" *wonderful things expected from them. And of this we*
" *have good aſſurance by what is come abroad from divers*
" *eminent perſons; among whom ſome are members of the*
" *Royal Society. And if it were not already excellently*
" *perform'd, I might ſpeak largely of the advantages that*
" *accrue to phyſic, by the induſtrious labour of ſuch chymiſts,*
" *as have only the diſcreet and ſober flame; and not the*
" *wild lightning of the others brains.*" *

Of the art, as 'tis purſued by the third kind of chymiſts, I ſhall here take no notice; but only as 'tis happily practiſed by the other two.

The office of chymiſtry is, by the application of fire, to ſeparate the parts of natural bodies into diſtinct parcels; and, by means of the ſame agent, to unite the parts of others into one whole. This is, nearly, the definition of that judicious chymiſt, M. Homberg.

Now the operations of chymiſtry being generally perform'd in tranſparent veſſels, upon known bodies, by known efficients, it is an art that, at firſt ſight, bids fair for improving both phyſic and philoſophy; ſince it eaſily preſents us with a great variety of reſolutions and compoſitions; and ſhews us the ſeveral ſteps that are taken to produce them. There are numberleſs bodies in nature, which the fire actually divides into ſeveral parts; according to their different degrees of volatility, gravity, or attraction; and unites others, as the texture, figure, and the attractive power of their parts determine. Hence, therefore, we have an opportunity of viewing nature, either in a more ſimple, or a more complex ſtate than that wherein ſhe, of her ſelf, appears. And this muſt neceſſarily lead to ſome diſcovery of the properties of different bodies; whereby philoſophy will be improved: and as the different parts, and different combinations of animal, mineral, and vegetable ſubſtances, have different medicinal virtues; phyſic will, by this means, receive improvement alſo.

* Dr. *Sprat*'s Hiſt. of the Royal Society, *p.* 37.

" *The*

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

The general fault committed herein, was, that from a few caſual experiments, they would needs account for all the diſeaſes in the human body, all the phenomena of nature, and all the myſteries of religion: for chymiſtry has had its enthuſiaſts. And doubtleſs, as managed by them, it has been the occaſion of much miſchief in the world.

Theſe errors, however, are not to be attributed to the art, but to the artiſts. And if ſome chymiſts have introduced errors into this art, they are happily expunged by others; as the diligent Boerhaave, *in a ſet diſcourſe, has abundantly proved* *

In ſhort, chymiſtry is another thing than what it formerly was; it has now made ample amends for all the darkneſs and obſcurity wherein it formerly involved the world. Their's were the clouds and ſmoke, but ours the flame and the light.

Let any more compare the Prælectiones Chymicæ *of Dr.* Freind, *with the commou* Tyrocinia *of chymical writers; the treatiſes of M.* Homberg, *with thoſe of* Tachenius; *and the chymical pieces of Mr.* Boyle, *with thoſe of* Helmont; *and he will be ſenſible of this difference.* †

Who can read the accounts, which Meſſieurs Homberg, Lemery, *and the illuſtrious* Newton, *give of the action of the ſun, and of fire, upon bodies, without being ſurpriz'd and delighted, at the proſpect it opens; and at the great length whereto, on ſolid and experimental grounds, it carries us in philoſophy? Theſe great men evidently demonſtrate, that fire is a grand, and an active principle in nature; that daſhing againſt bodies, 'tis abſorbed by them; that lodging it ſelf therein, it becomes the cauſe of all the light they give us; and that were it not for this admiſſion of its rays, our fluids would be ſolids, and our water ice.*

M. Homberg *ſhews, that the rays of the ſun exerciſe an actual force, or truſion; for he found, that a very light body,*

* Serm. Academ. de Chemiâ.

† Qui *Hombergiana Tachenio, Helmontio Boyleana*; qui vulgatos tirociniorum ſcriptores contulerit cum iis quæ in miſcellaneis *Germanorum*, in monumentis *Gallicis*, in *Britannicis* jam habentur commentariis, prudens ferat judicium; nec juſtum hujus calculum reformidabo. *Boerhaave* in Serm Acad. de Chem. p. 21.

ex-

expoſed to the focus of a burning-glaſs, would be turned over upon the matter whereon 'twas laid; and that the rays, thrown, by ſtarts, thro' a ſmall lens, upon the ſpring of a watch, ſtraiten'd and ſtuck with one end into a board, made it vibrate; as if it had been puſh'd with a ſtick. †

"*The ſun, ſays M.* Lemery, *may be conſidered as the grand* " *reſervatory of luminous matter; and all inflammable bodies,* " *as little reſervatories ſubſervient to him; that, as ſo many* " *little ſuns, occaſionally ſupply our neceſſities.*"

M. Homberg *farther ſhews us, that* " *the light of the ſun* " *impinging againſt terreſtrial bodies, modifies them accord-* " *ing to their ſeveral textures: thus ſome, as water, it* " *eaſily keeps fluid; of others, it forms oily, unctuous bodies;* " *and makes inflammable ſubſtances of ſalts, of earth, and of* " *water; none of which are, of themſelves, inflammable; ſo* " *that the other chymical principles of bodies, ſerve chiefly to* " *detain this, or to be changed by its actions upon them.*" " *The luminous matter,*" *according to the ſame excellent chymiſt,* " *inſinuates it ſelf into the ſubſtance of bodies, to* " *produce their ſulphur; changes the arrangement of their* " *parts; increaſes them, and, by conſequence, alters the ſub-* " *ſtance of the body it ſelf, after as many different manners, as* " *in different quantities it can be differently placed; whence* " *proceeds an infinite variety. So that, would we compare* " *the variety of the materials which exiſt, with thoſe which* " *might be brought into being, by all the combinations poſſible* " *to be made; we muſt ſay, that the univerſe, ſo far as we* " *know of it, is but very ſmall, in compariſon of what it might* " *be; and that, if there were ſeveral worlds, formed like* " *this of ours, they might all be differently furniſhed with* " *objects, without changing either the manner, or the matter* " *of the bodies, whereof they ſhould conſiſt: which demon-* " *ſtrates an infinite contrivance and power in the Being who* " *made the univerſe.*"

And a ſtill greater philoſopher, prompted by chymical experiments, demands, whether " *groſs bodies, and light, are not*

† Hiſt. de l'Acad. A. 1708. p. 25.

" *convertible into one another; and may not,*" *ſays he,* " *bodies*
" *receive much of their activity, from the particles of light*
" *which enter their compoſition? For all fixed bodies, being*
" *heated, emit light, ſo long as they continue ſufficiently hot;*
" *and light mutually ſtops in bodies, as often as its rays*
" *ſtrike upon their parts. I know no body leſs apt to ſhine,*
" *than water; yet water, by frequent diſtillations, changes*
" *into fixt earth, as Mr.* Boyle *has tried; and then this*
" *earth, being enabled to endure a ſufficient heat, ſhines by*
" *heat like other bodies.*"

" *And to ſhew to what noble purpoſes ſuch conſiderations may ſerve, I ſhall add, from the ſame great philoſopher, that* " *the ſun's heat is as the denſity of its rays; that is,*
" *reciprocally, as the ſquare of the diſtance of the place*
" *from the ſun; and therefore, ſince the diſtance of the comet,*
" *in the year* 1680, (*that comet being on the* 8th *of* December,
" *in its perihelion,*) *was from the ſun's centre, to the di-*
" *ſtance of the earth from the ſame, as about* 6 *to* 1000;
" *the ſun's heat at the comet, was, then, to the ſummer's*
" *heat with us, as* 28,000 *to* 1. *But the heat of boiling*
" *water, is about three times as great, as the heat that*
" *dry earth receives from the ſummer's ſun; and the heat*
" *of glowing iron, is three or four times greater than the*
" *heat of boiling water; conſequently, the dry earth in this*
" *comet, in its perihelion, might receive a heat from the*
" *ſun's rays,* 2000 *greater than that of red-hot iron: a*
" *heat ſufficient, immediately to diſſipate and conſume all*
" *manner of vapours, exhalations, and volatile ſubſtances!*

" *This comet, therefore, received an immenſe degree of*
" *heat from the ſun; and this heat it might preſerve for*
" *a very long time. A ſphere of glowing iron, one inch in*
" *diameter, will ſcarce loſe all its heat in the ſpace of an*
" *hour, when expoſed to the air; and a larger ſphere would*
" *longer preſerve its heat, in proportion to its diameter:*
" *whence a globe of red-hot iron, equal to our earth, that*
" *is about* 40,000,000 *feet in diameter, would require* 50,000
" *years to cool in.**

* Newton. Princip. p. 466, 467.

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But if any one shall still retain a doubt of the worth and abilities of chymistry, to reward those who cultivate it; let him consider the practice and procedure of the happiest philosopher the world ever yet cou'd boast, the great Sir Isaac Newton; *who, when he demonstrates the laws, the actions, and the powers of bodies, from a consideration of their effects, always produces chymical experiments for his vouchers; and when, to solve other phenomena, he makes use of these powers, his refuge is to chymistry; whence he manifestly shews, that without the assistance of this art, even he cou'd hardly have explained the peculiar nature and properties of particular bodies.**

That chymistry has furnished the shops with many excellent preparations, and such as have several advantages over the common Galenic *remedies, is now too generally allow'd, to need that particular examples shou'd be produc'd of it. That this art, also, meliorates several metalline and mineral bodies, and supplies many substances, useful in particular trades, and in several occurrences of human life, is a matter of fact acknowledg'd by all who are acquainted with the art, and its productions; so that it were time misspent, by an induction of more particulars, to shew its usefulness to mankind, both in philosophy and physic.*

'Tis evident, therefore, that nothing but an intire ignorance of chymistry can cause it to be ill spoken of; and that it is so far from being an employment unworthy of a gentleman and a philosopher; that it is one of the principal whereto he ought to addict himself, who wou'd improve either philosophy or physic.†

* Desino igitur sed in eo, in quo ultimam perspicientiæ humanæ metam posuisse videtur natura, *Isaaco Newtono*. Ille, licet adeo felix ut cum vivente de principatu in philosophiâ contendat nemo sanus, quando leges, actiones, vires corporum ex perpensis demonstrat effectis, non aliud quam chemiam allegat; quando inventas ibi vires iterum extricandis applicat phænomenis, mera chemica advocat, claroque testatur exemplo, abfuisset chemia, singularium corporum propriam indolem, proprias vires, vix potuisse mortalium perspicacissimo cognosci. *Boerhav. Serm. Acad. de Chemiâ, p.* 39, 40.

† In physicis nil desperandum hâc (i. e. chemia) duce; omnia bona ab hâc speranda in medicis; abditissima revelare, extricare impedita, latentes corporum vires detegere, imitari, dirigere, mutare, applicare, perficere, docet fideliſſime. *Boerhav. Serm de Chem. p.* 38, 39.

THE

THE

SCEPTICAL CHYMIST:

OR,

CONSIDERATIONS

UPON THE

Experiments uſually produced in favour of the four elements, and the three chymical principles of mixed bodies.

SECT. I.

NOtwithſtanding the ſubtile reaſonings of the *Peripatetics*, and the pretty experiments of the chymiſts, I am ſo diffident as to think, that if neither can produce more cogent arguments, for the truth of their aſſertion, than are uſually given; a man may reaſonably doubt as to the number of thoſe material ingredients of mixed bodies, which ſome call elements, and others principles.

The number of the Peripatetic *elements, and chymical principles doubtful.*

Indeed, when I conſider'd, that theſe principles are as eſſential in natural philoſophy, as the real elements themſelves are in the univerſe; I expected to find them ſolidly eſtabliſhed. But upon impartially examining the bodies themſelves, which are ſaid to reſult from the blended elements; and torturing them into a confeſſion of their conſtituent principles; I was quickly induc'd to think, that the number of them had been contended for with more earneſtneſs than ſucceſs.

The words element, and principle, are here uſed as equivalent terms; and ſignify thoſe primitive and ſimple bodies, of which the mix'd ones are ſaid to be compos'd; and into which they are ultimately reſolv'd.

Elements and principles, what?

'Tis

Chymiſtry.

Arguments for the four elements

'Tis ſaid, that a piece of green wood, by burning, diſcovers the four elements of which mixed bodies are compoſed: the fire appearing in the flame, by its own light; the ſmoak aſcending, and readily turning into air, as a river mixes with the ſea; the water, in its own form, boiling out at the ends of the ſtick; and the aſhes remaining for the element of earth.

This doctrine of the four elements is, alſo, ſaid to have been deliver'd by *Ariſtotle*, as the reſult of his ſtudy and application, in comparing the theories of the former philoſophers; and that it has, ever ſince, been univerſally embraced by men of learning, till *Paracelſus*, and a few other chymiſts, deny'd it, and aſſerted only three principles, which they endeavoured to diſguiſe by the terms, ſalt, ſulphur, and mercury.*

Conſider'd.

But by this experiment it ſhould appear, that the elements are made of mix'd bodies, rather than mix'd bodies of the elements. For in wood, thus analyz'd, and other bodies diſſipated and alter'd by the fire, it appears, that the ſuppoſed elementary fire and water are made out of the concrete; not that the concrete was made up of fire and water. And, it has never, that I know of, been prov'd, that nothing can be obtained by committing a body to the fire, that was not pre-exiſtent in the body.

'Tis true, when a refiner, mixing gold and lead, expoſes them upon the cupel to a violent fire; he thereby ſeparates the mixture into its component ingredients, gold, and lead, which, driven off with the droſs of the nobler metal, makes litharge of gold.

But then we do not ſee nature pull down a parcel of the element of fire from, where 'tis fancied to be plac'd, near the orb of the moon, and blend it with a quantity of each of the three other elements, to compoſe every mix'd body; as we ſee the refiner take both gold and lead to compoſe the maſs we ſpeak of. Beſides, it remains to be proved, that the fire only takes the elementary ingredients aſunder, without cauſing any other alteration; for otherwiſe, bodies may afford ſubſtances which were not pre-exiſtent in them; as fleſh, too long kept, produces maggots, *&c.* Now that the fire does not always barely ſeparate the elementary parts, but, ſometimes at leaſt, alters the ingredients of

* The judicious M. *Homberg*, who has greatly improved the art of chymiſtry, or rather advanced a new one, gives us the following account of the three chymical principles. The ſaline principle is, according to him, a matter ſoluble in water, and unreſolvable by the fire; being the acid ſubſtance, and general baſis of all ſalts; tho' never to be found in a pure and unmixed ſtate

This author, by numerous experiments, made with the utmoſt care, cou'd never obtain any ſulphureous principle from bodies; and brings ſeveral arguments to prove, that ſuch a principle is, in reality, fire or light, ſtriking againſt, reſiding in, and acting upon bodies.

The principle, mercury, is, according to the ſame candid chymiſt, a real quick-ſilver, or liquid ſubſtance, perfectly reſembling a fluid metal; being nearly of the ſame weight with ſilver, and wetting nothing but metals. See *French Memoirs*, *A.* 1702. *p.* 4. *A.* 1705. *p.* 117. *A.* 1708. *p.* 404. *A.* 1709. *p.* 133.

bodies,

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry. their coalitions, conſtituted ſuch numerous, little, primary concretions, as were not eaſily ſeparable into the particles that compoſed them.

Gold will mix and fuſe, not only with ſilver, copper, tin, and lead; but with antimony, *Regulus Martis*, and many other minerals; and thereby compoſe bodies, very different both from gold, and the other ingredients of the reſulting concretes. The ſame gold may alſo, by common *Aqua regia*, and ſeveral other menſtrua, be reduc'd into a ſeeming liquor; ſo that the corpuſcles of the metal will, with thoſe of the menſtrua, paſs thro' paper; and with them coagulate into a cryſtalline ſalt. And further, with a ſmall quantity of a certain ſaline ſubſtance, I can eaſily ſublime gold into the form of long cryſtals: and by many other ways may gold be diſguiz'd, and help to conſtitute bodies of very different natures, both from it ſelf, and from one another; yet be afterwards reduced to the ſame numerical, yellow, fixed, ponderous, malleable ſubſtance, it was before its mixture. And not only the moſt fixed, but alſo the moſt fugitive of metals, conſpires to favour our aſſertion; for quick-ſilver will, with ſeveral metals, compoſe an amalgam; with ſeveral menſtrua, it ſeems to be turned into a liquor; with *Aqua fortis*, it will be brought into either a red, or a white precipitate; with oil of vitriol, into one of a pale yellow; with ſulphur, it will compoſe a blood-red volatile cinnabar; with ſome ſaline bodies, it will aſcend in form of a ſalt, diſſoluble in water; with *Regulus* of antimony, and ſilver, I have ſeen it ſublim'd into a kind of cryſtals; with another mixture, I reduced it into a malleable body; and into a hard brittle ſubſtance by another: and ſome there are, who affirm, that by proper additions, they can reduce quick-ſilver into an oil; nay, into glaſs; yet out of all theſe compounds, we may recover the very ſame running mercury, that was the principal diſguiz'd ingredient of them. Hence it appears not abſurd to conceive, that little primary maſſes, or cluſters, may remain undiſſipated, notwithſtanding they enter the compoſition of various concretions; ſince the corpuſcles of gold and mercury, tho' not primary concretions of the moſt minute particles of matter, but confeſſedly mix'd bodies, are able, plentifully, to concur to the compoſition of ſeveral very different bodies, without loſing their own nature, or texture, or having their coheſion violated by the loſs of their aſſociated parts, or ingredients.*

And

* Concerning the nature, and various forms of bodies, and the ſulphur they contain, take the words of one, who ſeems thoroughly to have conſider'd them. "Al-
" tho' a pſeudo-topaz, ſays Sir *Iſ. Newton*,
" a *Selenites*, rock-cryſtal, iſland-cryſtal,
" vulgar glaſs, (that is, ſand melted toge-
" ther,) and glaſs of antimony; which
" are terreſtrial, ſtony, alcalizate concretes;
" and air, which, probably, ariſes from
" ſuch ſubſtances by fermentation; be ſub-
" ſtances very differing from one another
" in denſity; yet they have their refractive
" powers almoſt in the ſame proportion
" to one another, as their denſities; except
" in that the refraction of that ſtrange ſub-
ſtance,

Chymiſtry.

A great variety of compounds may ariſe from a few ingredients.

And as confidently as ſome chymiſts, &c. object againſt the *Peripatetics*, that from the mixture of their four elements, there could ariſe but an inconſiderable variety of compound bodies; yet if the *Ariſtotelians* were half ſo well vers'd in the works of nature, as in the writings of their maſter, this objection would not triumph for want of experiments to ſhew the contrary. For if we aſſign to the corpuſcles, whereof each element conſiſts, a peculiar ſize and ſhape, it were eaſie to ſhew, that ſuch differently figured corpuſcles, may mixed in ſuch various proportions, and be connected ſo many ſeveral ways, that an almoſt incredible number of variouſly qualified concretes,

" ſtance, iſland-cryſtal, is a little bigger than " the reſt. And particularly air, which is " 3500 times rarer than the pſeudo-topaz, " and 4400 times rarer than glaſs of antimo- " ny, and 2000 times rarer than the ſele- " nites, glaſs vulgar, or cryſtal of the rock, " has, notwithſtanding its rarity, the ſame " refractive power in reſpect of its denſity, " which thoſe very ſubſtances have with re- " ſpect to theirs; excepting ſo far as thoſe " differ from one another. Again; the re- " fraction of camphire, oil-olive; linſeed- " oil, ſpirit of turpentine and amber; which " are fat, ſulphureous, unctuous bodies; and " a diamond, which, probably, is an unctu- " ous ſubſtance coagulated, have their re- " fractive powers in proportion to one ano- " ther, as their denſities, without any conſi- " derable variation. But the refractive pow- " ers of theſe unctuous ſubſtances are two or " three times greater, in reſpect of their " denſities, than the refractive powers of the " former ſubſtances, in reſpect of theirs. " Water has a refractive power in a middle " degree, between thoſe two ſorts of ſub- " ſtances; and, probably, is of a middle na- " ture; for out of it grow all vegetable and " animal ſubſtances; which conſiſt as well " of ſulphureous, fat, and inflammable parts, " as of earthy, lean, and alcalizate ones. Salts " and vitriols have refractive powers in a " middle degree, between thoſe of earthy " ſubſtances and water; and, accordingly, " are compoſed of thoſe two ſorts of ſubſtan- " ces. For by diſtillation, and rectification " of their ſpirits, a great part of them goes " into water; and a great part remains be- " hind, in the form of a dry, fixed earth, " capable of vitrification. Spirit of wine " has a refractive power in a middle degree, " between thoſe of water and oily ſubſtan- " ces; and, accordingly, ſeems to be com- " poſed of both, united by fermentation; " the water, by means of ſome ſaline ſpirits, " with which 'tis impregnated, diſſolving the " oil, and volatilizing it by the action. For " ſpirit of wine is inflammable, by means " of its oily parts; and being diſtilled often " from ſalt of tartar, grows by every di- " ſtillation more and more aqueous and " phlegmatic. And chymiſts obſerve, that " vegetables, diſtilled *per ſe*, before fer- " mentation, yield oils without any burn- " ing ſpirits; but after fermentation, yield " ardent ſpirits, without oils; which ſhews, " that their oil is by fermentation conver- " ted into ſpirit. They find alſo, that if " oils be poured, in ſmall quantity, upon " fermenting vegetables, they diſtil over, " after fermentation, in the form of ſpirits. " Since then all bodies ſeem to have their " refractive powers proportional to their " denſities, or very nearly, excepting ſo far " as they partake more or leſs of ſulphu- " reous, oily particles; and thereby have " their refractive powers made greater; it " ſeems rational to attribute the refracting " power of all bodies, chiefly, if not wholly, " to the ſulphureous parts with which they " abound. For it's probable, that all bo- " dies, more or leſs, abound with ſulphurs. " And as light, congregated by a burning " glaſs, acts moſt upon ſulphureous bodies, " to turn them into flame and fire; ſo, " ſince all action is mutual, ſulphurs ought " to act moſt upon light. For that the acti- " on between light and bodies is mutual, " appears, in that the denſeſt bodies, which " refract and reflect light moſt ſtrongly, " grow hotteſt in the ſummer ſun, by the " action of the refracted or reflected light." *Newton. Optic.* p. 248——251.

Chymiſtry. may be compoſed of them. Nay, the corpuſcles of one element, may barely, by being aſſociated among themſelves, make up little maſſes of a different ſize and figure from their conſtituent parts; whilſt to the ſtrict union of ſuch minute bodies, there often ſeems nothing requiſite, but the bare contact of a great part of their ſurfaces. And how great a variety of phenomena, the ſame matter, without the addition of any other, only ſeveral ways diſpoſed or rang'd, is able to exhibit, may appear by the multitude of different engines, which, by the contrivance of ſkilful mechanics, and the dexterity of expert workmen, might be made of iron alone. But, in our caſe, being allowed to deduce compound bodies from four very differently qualified ſorts of matter; what we ſaid of new concretes reſulting from the mixture of incorporated minerals, will not admit it to be doubted, that four elements, managed by the ſkill of nature, may afford a multitude of different compounds.

But the *Ariſtotelian* hypotheſis, is not comparable to the mechanic doctrine of the bulk and figure of the ſmalleſt parts of matter; for from theſe more univerſal and fruitful principles of the elementary matter, may ſpring a great variety of textures; upon whoſe account, a multitude of compound bodies, might greatly differ from one another. What is here ſaid of the four *Peripatetic* elements, may be alſo applied, *mutatis mutandis*, to the chymical principles. And both of them muſt, I fear, call in to their aſſiſtance, ſomething that is not elementary, to excite, or regulate the motion of the parts of matter, and diſpoſe them after the manner requiſite to conſtitute particular concretes.

Various ſubſtances obtainable from bodies, by fire.

From moſt of thoſe mixed bodies, which partake either of an animal, or a vegetable nature, there may, perhaps, by the help of the fire, be obtained a determinate number of ſubſtances, deſerving different denominations.

The truth of this aſſertion ſeems manifeſt, or, however, will ſufficiently appear hereafter.

It may, likewiſe, be granted, that thoſe diſtinct ſubſtances, which concretes either generally afford, or conſiſt of, may, without great inconvenience, be called the elements, or principles of them.

Whether fire be the proper inſtrument for analyzing mixed bodies.

Notwithſtanding what common chymiſts have taught, it may reaſonably be doubted, how far, and in what ſenſe, fire ought to be eſteemed the genuine and univerſal inſtrument of analyzing mixed bodies.

It were to be wiſh'd, our chymiſts had told us clearly, what kind of diviſion of bodies by fire, muſt determine the number of the elements: for it is not near ſo eaſy, as many think, to determine diſtinctly the effects of heat. Thus guaiacum, for inſtance, burnt with an open fire, is reduced into aſhes and ſoot; tho' the ſame wood, diſtilled in a retort, is reſolv'd into oil, ſpirit, vinegar, water, and charcoal;

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Chymiſtry. in cloſe veſſels, no ſeparation is made of ſuch a volatile ſalt as wood affords, when 'tis firſt, by an open fire, divided into aſhes and ſoot, and that ſoot is afterwards plac'd in a ſtrong retort, and compell'd, by an urgent fire, to part with its ſpirit, oil, and ſalt; for tho' I dare not peremptorily deny, that in the liquors of guaiacum, and other woods, diſtill'd in retorts after the common manner, there may be ſaline parts, which, by reaſon of the analogy, may pretend to the name of ſome kind of volatile ſalt; yet, queſtionleſs, there is a great difference betwixt ſuch ſalts, and that we have, ſometimes, obtain'd upon the firſt diſtillation of ſoot. For we cou'd never yet ſee ſeparated from woods, analyz'd only after the vulgar manner, in cloſe veſſels, any volatile ſalt in a dry and ſaline form, as that of ſoot; which we have often had very cryſtalline and geometrically figured. And then as the ſaline parts of the ſpirits of guaiacum, *&c.* appear ſluggiſh upon diſtillation, the ſalt of ſoot ſeems to be one of the moſt volatile bodies in nature; and if it be well made, will readily aſcend with the mild heat of a furnace, warm'd only by the ſingle wieck of a lamp, to the top of the higheſt glaſs-veſſels, commonly made uſe of for diſtillation. Beſides all this; the taſt and ſcent of the ſalt of ſoot are exceeding different from thoſe of the ſpirit of guaiacum, *&c.* for the former, not only ſmells and taſts much leſs like a vegetable ſalt, than like that of harts-horn, and other animal concretes; but in many other properties ſeems more allied to the family of animal, than to that of vegetable ſalts. I might ſhew, by other examples, that the chymiſts, to have dealt clearly, ought to have more explicitly and particularly declared, by what degrees of fire, and in what manner of application of it, they wou'd have us judge a diviſion, made by its means, to be a true analyſis into their principles. But I proceed to mention other particular reaſons why I doubt, whether fire be the true and univerſal analyzer of mix'd bodies.

In the next place, I obſerve there are ſome mix'd bodies, from which it has not yet been made appear, that any degree of fire can ſeparate either ſalt, or ſulphur, or mercury, much leſs all the three. The moſt obvious inſtance of this truth is gold; a body ſo fix'd and wherein the elementary ingredients, if it has any, are ſo firmly united to each other; that we find not in the operations, wherein gold is expoſed to the moſt vehement fire, that it, diſcernibly, ſo much as loſes of its fixedneſs or weight; ſo far is it from being reſolv'd into thoſe principles, whereof one, at leaſt, is acknowledg'd to be fugitive. *Gaſto Claveus*, who, tho' a lawyer by profeſſion, ſeems to have had no ſmall curioſity and experience in chymiſtry, relates, that having put into one ſmall earthen veſſel an ounce of the moſt pure gold, and into another the like weight of pure ſilver, he placed them both in that part of a glaſs-houſe furnace, wherein the workmen keep their metal continually melted; and that having there kept both the gold

and

and the silver in constant fusion, for two months together, he afterwards took them out of the furnace; and weighing both of them again, found, that the silver had not lost above a twelfth part of its weight, and the gold nothing at all. *

And tho', perhaps, there be no other body so perfectly fix'd as gold; yet there are many others so compos'd, that I have not yet observ'd the fire to separate from them any one of the chymical principles. I need not relate what complaints the more candid and judicious chymists themselves make of those boasters, who confidently pretend, they have extracted the salt or sulphur of quicksilver, when they only disguize it, till it resembles the concretes, whose names are given it; whilst, by a skilful and rigid examination, it may be easily stript of its dress, and made to appear again in the pristine form of running mercury: these pretended salts and sulphurs being so far from elementary parts, extracted out of mercury, that they are rather re-compounded bodies, made up of the whole metal and the menstruum, or other additions. And as for silver, I never saw any degree of fire make it part with so much as one of its three principles. The experiment of *Claveus* might, indeed, give a suspicion, that silver may be dissipated by fire, provided it be extremely violent, and very lasting; yet it will not, necessarily, follow, that, because the fire was able, at length, to make the silver lose a little of its weight, it was, therefore, able to dissipate it into its principles; for I have observ'd little grains of silver to lie hid in the small cavities of crucibles, wherein that metal had been long kept in fusion; whence some goldsmiths of my acquaintance make a profit, by grinding such crucibles to powder, to recover out of them the latent particles of silver; and hence I might argue, that, perhaps, *Claveus* was mistaken, and imagin'd that silver to have been driven away by the fire, which, indeed, lay in minute parts, hid in his crucible; for so small a quantity as he miss'd, of so ponderous a body, might be easily conceal'd in the pores thereof.

But admitting, that some parts of the silver were driven away by the violence of the fire; what proof is there that it was either the salt, the sulphur, or the mercury of the metal, and not rather a part of it, homogeneous to what remain'd? For, besides that the silver left behind, seem'd not sensibly alter'd, which it, probably, would have appeared, had so much of any one of its principles been separated from it; we find in other mineral bodies, of a less permanent nature, that the fire may divide them into such minute parts, as to carry them away with it self; without at all destroying their nature. Thus we see, that in the refining of silver, the lead that is mix'd therewith,

* Gold exposed to the sun's rays, thrown to a point, either by a large glass lens, or a burning concave, will fume, be scattered, and dissipated into small drops, be vitrified and lose of its weight; whence, says M. *Homberg*, this noble metal is not so fixed as chymists commonly pretend: and thus, all metals are volatile with regard to a heat sufficiently vehement. See *French Memoirs*, *A.* 1702. *p.* 186---197.

to

Chymiſtry. to carry away the copper, or other ignoble mineral that debaſes it, will, if let alone, evaporate in time, upon the teſt; but if, as 'tis moſt uſual amongſt ſuch as refine great quantities of metals together, the lead be blown off from the ſilver, by bellows; that which wou'd, otherwiſe, have eſcaped in the form of unheeded ſteams, will, in great part, be collected near the ſilver, in the form of a darkiſh powder, call'd, litharge of ſilver. And thus *Agricola* informs us, when copper, or the ore of it, is fuſed by the violence of the fire with *Cadmia*; ſome of the ſparks, which, in great multitudes, fly upwards, ſtick to the vaulted roofs of the furnaces, in the form of little white bubbles, which, therefore, the *Greeks* call *Pompholyx*; whilſt others more heavy, partly adhere to the ſides of the furnace, or fall to the ground; and by reaſon of their aſhy colour, as well as weight, are termed σποδὸς. I might add, I have not found, that from *Venetian* talc, from the *Lapis Oſſifragus*, or *Oſteocolla*, from *Muſcovy* glaſs, from pure and fuſible ſand, *&c.* ſuch of my acquaintance as have try'd, were able, by the fire, to ſeparate any one of the hypoſtatical principles. Glaſs, we know, is made by the pure colliquation of the ſalt and earth, remaining in the aſhes of a burnt plant; yet common glaſs ſo far reſiſts the violence of the fire, that moſt chymiſts think it a body leſs apt to be deſtroyed than gold it ſelf. But if the artificer can ſo firmly unite ſuch comparitively groſs particles, as thoſe of earth and ſalt, that make up common aſhes, into a body indiſſoluble by fire; why may not nature aſſociate, in ſeveral bodies, the more minute elementary corpuſcles, too firmly, to let them be parted by the fire? Having put a quantity of camphire into a glaſs-veſſel, and plac'd it in a gentle heat, I found it to ſublime to the top of the veſſel in flowers; without leaving the weight of a ſingle grain behind: and theſe in whiteneſs, ſmell, *&c.* ſeemed not to differ from the camphire it ſelf. *Helmont* affirms, that a coal, kept in a glaſs exactly cloſe, will not be calcined to aſhes; tho' detain'd ever ſo long in a ſtrong fire. And indeed, having ſometimes diſtilled ſuch woods as box; whilſt our *Caput mortuum* remain'd in the retort, it continued black, like charcoal, tho' the retort were of earth, and kept red-hot in a vehement fire; but as ſoon as ever it was brought out of that veſſel into the open air, the burning coals would ſuddenly degenerate, or fall aſunder, without the aſſiſtance of any new calcination, into pure white aſhes. Laſtly, 'tis known, that common ſulphur, if pure, and freed from its vinegar, leiſurely ſublimed in cloſe veſſels, riſes into dry flowers; which may be preſently melted into a body, of the ſame nature with that which afforded them: tho' if brimſtone be burnt in the open air, it yields a penetrating fume, which being caught in a glaſs-bell, condenſes into that acid liquor, called, oil of ſulphur *per campanam*. Hence it appears, that even among the bodies that are not fixed, there are ſeveral of ſuch a texture, that the fire, as chymiſts employ it, cannot eaſily reſolve them into elementary ſubſtances. For, ſome bodies being of ſuch a texture, that the fire can drive

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry.

at to do it; tho' they may be very eaſily parted by ſpirit of nitre, or *Aqua fortis*. Thus, likewiſe, the metalline part of vitriol, will not be ſo eaſily and conveniently ſeparated from the ſaline, even by a violent fire, as by the affuſion of certain alkaline ſalts, in a liquid form, upon the ſolution of vitriol made in common water. For hereby the acid ſalt of the vitriol, leaving the copper it had corroded, to join with the ſalts that were added; the metalline part will be precipitated to the bottom, almoſt like mud. The vulgar chymiſts have not been able, by fire alone, to ſeparate pure ſulphur from antimony; but tho' there are in their books many plauſible proceſſes for extracting it, yet he who ſhall make as many fruitleſs trials, as I have done, to obtain it by moſt of them, will be eaſily perſuaded, that the productions of ſuch proceſſes are antimonial ſulphurs, rather in name, than nature. But tho' antimony, ſublimed by it ſelf, is reduced only to a volatile powder, or to antimonial flowers, of a compound nature, like the mineral that affords them; yet I have, by a particular method, ſublimed out of antimony, a larger proportion of ſulphur, than ever I otherwiſe ſaw obtain'd out of that mineral. For, having digeſted eight ounces of fine pulverized antimony, with twelve ounces of oil of vitriol, in a well clos'd glaſs, for about ſix or ſeven weeks; and having cauſed the maſs, now grown hard and brittle, to be diſtilled in a retort placed in ſand, with a ſtrong fire; we found the antimony to be ſo open'd, or alter'd, by the menſtruum, wherewith it had been digeſted, that tho' crude antimony, forced up by the fire, riſes only in flowers, ours, thus treated, afforded in the receiver, and at the top of the retort, about an ounce of ſulphur, yellow and

ſilver in two pieces, and ſome grains above it, cover'd over with the ſalts. By repeated trials, M. *Homberg* afterwards found, that to make the ſeparation exact, the quantity of the metals ought to be nearly equal; and that the fire muſt not be violent. He farther obſerves, that the ſalts, whilſt they are not in perfect fuſion, ſuſtain the mixed metal, when it begins to melt, and ſerve as a kind of ſieve to it; permitting the heavier part, the gold, to paſs through, and retaining the lighter, the ſilver, which in this caſe, is not ſo well fuſed as the gold. So that, if at the right juncture, the crucible be taken from the fire, the ſilver preſently hardens; being become fine, upon ſeparating from the gold, and cannot be fuſed again, without a violent fire. The ſalts, in the mean time, which ſuſtain this ſilver, being but imperfectly fuſed, prevent the ſilver from falling to the bottom of the crucible, and mixing again with the gold. *French Memoirs, A.* 1713. *p.* 89—91.

He, likewiſe, ſhews, that when ſilver is debaſed by copper, it may, with great eaſe and cheapneſs, be excellently purified, by calcining it with half its weight of common brimſtone; and when the whole is melted together, throwing on, at ſeveral times, a ſufficient quantity of the filings of iron, which quantity may be eaſily judged of in the operation. By this means, the ſulphur will immediately leave the ſilver, and unite with the iron and copper; and turning to droſs, float at the top, and leave the ſilver pure at the bottom of the crucible. The proceſs muſt be ſtopp'd, as ſoon as ever the iron is perfectly fuſed; otherwiſe, a part of the copper will be precipitated, and mixing with the ſilver, cauſe the work to be began afreſh. *French Memoirs, A.* 1701. *p.* 53—56.

brittle,

brittle, like common brimſtone; and of ſo ſulphureous a ſmell, that, upon unluting the veſſels, it infected the room with a fetor ſcarce ſupportable. This ſulphur had alſo the perfect inflammability of common brimſtone; and would immediately kindle at the flame of a candle, and burn blue like that. The long digeſtion, indeed, wherein our antimony and menſtruum were detained, ſeem'd conducive to the better unlocking of the mineral; yet, by incorporating with powder'd antimony, a convenient quantity of oil of vitriol, and committing them immediately to diſtillation, there may be obtained a little ſulphur, like the common, and more combuſtible than, perhaps, will at firſt be taken notice of. For I have obſerved, that after its being firſt kindled, the flame would ſometimes go out too ſoon of it ſelf; but if the ſame lump were held again to the candle, it would rekindle, and burn for a pretty while, even after the third or fourth extinction. As ſomething ſulphureous may be diſcover'd in oil of vitriol, 'tis natural to ſuſpect, either that this ſubſtance was ſome ſulphur which lay hid in that liquor, and was, by this operation only, reduced into a manifeſt body; or elſe, that it was a compound of the unctuous parts of the antimony, and the ſaline ones of the vitriol: becauſe many would have ſulphur to be only a mixture, made in the bowels of the earth, of vitriolic ſpirits, and a certain combuſtible ſubſtance *. But the quantity of ſulphur we obtained by digeſtion, was much too great to have been latent in the oil of vitriol; and that vitriolic ſpirits are not neceſſary to the conſtruction of ſuch a ſulphur as ours, I could eaſily manifeſt, from the ſeveral ways by which I have obtained, tho' not in ſuch plenty, a ſulphur of antimony, colour'd and cumbuſtible like common brimſtone. And to ſhew, that diſtill'd, vitriolic ſpirits, are not neceſſary to be obtaining of ſuch a ſulphur, as we have been conſidering; I did, by the bare diſtillation of ſpirit of nitre, from its weight of crude antimony, ſoon ſeparate a yellow, and very inflammable ſulphur; which, for ought I know, deſerves as much the name of an element, as any thing the chymiſts ſeparate from any mineral by the fire. And tho' the urinous and common ſalts, whereof ſal-armoniac conſiſts, remain'd, as we ſaid, unſever'd by the fire, in many ſucceſſive ſublimations; yet, they may be eaſily ſeparated, by pouring upon the concrete, finely powder'd, a ſolution of ſalt of tartar, or of the ſalt of wood-aſhes, for, upon diligently mixing of theſe, a very ſtrong ſcent of urine will enſue: and, perhaps, a ſharp pain in the eyes, if held too near. Both theſe effects proceed from hence, that by the alkaline ſalt, the

* M. *Geoffroy* ſhews, that the mixture of any vitriolic ſalts with inflammable ſubſtances, will yield common brimſtone; and by the different compoſitions he has made of ſulphur, and particularly from oil of vitriol, and oil of turpentine; and by the analyſis thereof, when thus prepared, he diſcover'd it to be nothing but the vitriolic ſalt, united with the cumbuſtible ſubſtance, *French Memoirs*, *A.* 1704. *p.* 381.

Chymistry. sea-salt that enter'd the composition of the sal-armoniac, is rendred more fixed; and thereby a divorce is made between it, and the volatile, urinous salt; which being, at once, set at liberty, and put into motion, begins presently to fly away, and to offend the nostrils and eyes it meets with in its way. And if the operation of these salts be, in convenient glasses, promoted by warmth, even that of a bath, the ascending steams may easily be caught, and reduced into a penetrant spirit, abounding with a salt; which I have sometimes found to be separable in a crystalline form. I might add, that tho' sublimate, consisting of salts and quick-silver, combined and carried up together by heat, may be many times sublimed by a like degree of fire, without suffering any divorce of the component bodies; yet the mercury will be easily sever'd from the adhering salts. But I rather observe, what may seem strange, that by such an addition, as seems only to promote the separation, there may easily be obtained from a concrete, that by the fire alone is readily divisible into all the elements whereof vegetables are supposed to consist, a similar substance, that differs in many respects from them all. For I have practis'd a way, whereby common tartar, without the addition of any thing that is not perfectly a mineral, except salt-petre, may, by one distillation, in an earthen retort, be made to afford plenty of real salt, ready dissoluble in water; which I found to be neither acid, nor of the smell of tartar; and to be almost as volatile as spirit of wine; and, indeed, of a very different nature from all that is usually separated by fire from tartar.

The fire, even when it divides a body into substances of various consistencies, does not commonly analyze it into hypostatical principles, but only disposes its parts into new textures; and thereby produces concretes, of a new, indeed, but compound nature. And this we shall abundantly make good hereafter.

Several distinct substances are obtainable from some concretes, without the assistance of fire; which no less deserve the name of elementary, than some which chymists extort by the violence of it.

We see, that the inflammable spirit of wine may not only be separated by the gentle heat of a bath, but may be distill'd, either by the help of the sun-beams, or even of a dunghill; being, indeed, of so fugitive a nature, that it is not easy to keep it from flying away, even without the application of external heat. I have likewise observed, that a vessel full of urine, being plac'd in a dunghill, the putrefaction, after some weeks, usually opens the body; so that the parts disbanding the saline spirit, will, within no very long time, if the vessel be not stopt, fly away of it self; whence from such urine, I have been able to distil little or nothing, besides a nauseous phlegm; instead of the active and piercing salt, and spirit that it would have afforded, when first expos'd to the fire, if the vessel had been carefully stopt.

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Chymiſtry. teſtimony of a perſon, acknowledged one of the greateſt in their way; they muſt not deny, that there is in nature another agent, able to analize compound bodies with leſs violence, more genuinely and more univerſally than the fire. And, for my own part, tho' I always ſay, in caſe of any ſtrange experiment; "he who hath ſeen it, hath more "reaſon to believe it, than he who has not;" yet I have found *Helmont* ſo faithful a writer, even in ſeveral of his improbable experiments, that I think it ſomewhat harſh to give him the lie; eſpecially in what he delivers upon his own proper trial. And having received ſome things from very credible eye-witneſſes, and ſeen others my ſelf, which argue ſo ſtrongly, that a circulated ſalt, or a menſtruum, may, by being extracted from compound bodies, leave them more unlock'd, than a wary naturaliſt would eaſily credit; I dare not confidently meaſure the power of nature, and of art, by that of the menſtrua, and other inſtruments, which even eminent chymiſts employ, about the analizing of bodies; nor deny, that a menſtruum may, from a particular concrete, extract ſome apparently ſimilar ſubſtance, different from any obtainable from the ſame body, by whatever degree of fire, or manner of its application. And I am the more unwilling peremptorily to deny, that there may be ſuch openers of compound bodies; becauſe among the experiments which make me ſpeak thus cautiouſly, there were ſome in which it appear'd not that one of the ſubſtances, inſeparable by common fires and menſtrua, could retain any thing of the ſalt whereby the ſeparation was made.

Some chymiſts, I know, will here reply, that they pretend not, by fire alone, to ſeparate their hypoſtatical principles out of all compound bodies; it being ſufficient that the fire divides them into ſuch, tho' afterwards they employ other bodies to collect the ſimilar parts of the compound; as 'tis known, that tho' they make uſe of water to collect the ſaline parts of aſhes from the terreſtrial, wherewith they are blended; yet it is the fire only that incinerates bodies, and reduces the fixed part of them into the ſalt and earth, whereof aſhes conſiſt. But I here only argue againſt thoſe vulgar chymiſts, who themſelves believe, and would perſwade others, that the fire is not only an univerſal, but an adequate and ſufficient inſtrument to analyze mix'd bodies with. For, as to their practice of extracting the fix'd ſalt out of aſhes, by the affuſion of water, 'tis obvious to alledge, that the water only aſſembles together the ſalt, which the fire had before divided from the earth; as a ſieve does not further break the corn, but only bring together, into two diſtinct heaps, the flower, and the bran; whoſe corpuſcles before lay promiſcuouſly blended in the meal.

But tho' I allow the chymiſts, after the fire has done its office, the uſe of fair water to make their extractions with, in ſuch caſes wherein the water does not co-operate with the fire, to make the analyſis; yet

since I grant this, but upon ſuppoſition, that the water only waſhes off the ſaline particles which the fire alone has before extricated in the analyz'd body, it is not reaſonable to extend this conceſſion to other liquors that may add to what they diſſolve. *Chymiſtry.*

And this premis'd, I obſerve, that many of the preceding inſtances, are ſuch as the objection will not at all reach. For fire can no more, with the aſſiſtance of water, than without it, ſeparate any of the three principles from gold, ſilver, mercury, *&c.*

Hence we may infer, that fire is not an univerſal analyzer of mix'd bodies; ſince of the metals and minerals, wherein chymiſts have moſt exerciſed themſelves, there appear ſcarce any which they are able to analyze by fire, or from which they can unqueſtionably ſeparate, even any one of their hypoſtatical principles.

It will alſo remain true, notwithſtanding the objection, that there may be other ways than the uſual analyſis by fire, to ſeparate from a compound body ſubſtances, as homogeneous as thoſe which chymiſts ſcruple not to reckon among their three principles; that with convenient additions, ſuch ſubſtances may be ſeparated by the help of the fire, as cou'd not be ſo by the fire alone, witneſs the ſulphur of antimony; and laſtly, ſince it appears too, that the fire is but one of the inſtruments that muſt be employed in the reſolution of bodies; whenever any menſtruum or other addition is employed together with the fire, to obtain a ſulphur or a ſalt from a body, we may well take the freedom to examine, whether or no, that menſtruum hereby helps to ſeparate the principle obtain'd by it, or whether there intervenes not a coalition of the parts of the body wrought upon, with thoſe of the menſtruum; whence the produced concrete may be judg'd to reſult from the union of both. And it will be farther allowable for us to conſider, how far any ſubſtance, ſeparated by the help of ſuch addition, ought to paſs for one of the three principles; ſince by one way of handling the ſame mix'd body, it may, according to the nature of the addition, and the method of working upon it, yield ſubſtances different from thoſe it may afford by other additions, and a different method. Nay, they may, as we formerly ſaid, differ from any of the ſubſtances into which a concrete is diviſible by the fire without additions, tho', perhaps, thoſe additions do not, as ingredients, enter the compoſition of the body obtain'd; but only diverſify the operation of the fire upon the concrete, which, by the fire alone, may be divided into as great a number of different ſubſtances, as any of the chymiſts teach that of their elements to be.

But many *Peripatetics*, to prove fire the true analyzer of bodies, will plead, that it is the very definition of heat given by *Ariſtotle*, "to be "that which aſſembles things of a ſimilar, and disjoins thoſe of an op- "poſite nature." To which I anſwer, that this effect is far from being ſo eſſential to heat as 'tis generally imagin'd; for the true and genuine property of heat is rather to put in motion, and thereby diſſociate

the

Chymistry. the parts of bodies, and subdivide them without regard to their being homogeneous or heterogeneous; as appears in the boiling of water, the distillation of quick-silver, or the exposing of bodies to the action of fire; where all that the fire can do is, to divide the body into very minute parts, which are of the same nature with one another, and with their wholes, as their reduction, by condensation, proves! And even when the fire seems most to associate such things as are similar, and disjoin such as are dissimilar, it produces that effect only by accident; for the fire does but dissolve, or rather shatter the frame or structure that kept the heterogeneous parts of bodies together, under one common form; upon which dissolution the component particles of the mix'd body being freed and set at liberty, naturally, and often without any operation of the fire, associate themselves each with its like, or rather take those places which their several degrees of gravity or levity, fixedness or volatility, assign them. Thus in the distillation of human blood, the fire first begins to dissolve the cement of the body, when the water being the most volatile and easie to be extracted, is either by the fiery atoms, or the agitation they are put into by the fire, first carried up till forsaken by that which rais'd it, its own weight sinks it down into the receiver; but all this while the other principles of the concrete remain unsever'd, and require a stronger degree of heat to make a separation of its more fix'd elements; and therefore the fire must be increased to carry over the volatile salt and the spirit, which, tho' supposed to be different principles, and tho' really of a different consistence, are yet of an almost equal volatility. After these comes over the oil, and leaves behind the earth and the alkali; which, being equally fix'd, the fire fails to sever them, notwithstanding the definition of the schools. And if into a red hot iron retort, you cast the matter to be distill'd, you may observe, that the predominant fire will carry up all the volatile elements, confusedly, in one fume, which afterwards take their place in the receiver, either according to the degree of their respective gravity, or to the exigency of their several textures. Thus 'tis observable, that tho' oil, or liquid sulphur, be one of the elements, separated by the analysis, yet the heat which accidentally unites the particles of the other volatile principles, has not always the same operation on this; for there are several bodies which yield two kinds of oils, whereof the one sinks to the bottom of that spirit on which the other swims. And I have two oils, carefully made of the same parcel of human blood, which not only differ extremely in colour, but swim upon one another, without mixing; and if, by agitation, confounded, will, of themselves, separate again.

And that the fire often divides bodies, upon this account, that some of their parts are more fix'd, and others more volatile, how far soever either of the two may be from a pure, elementary nature, is obvious enough, in the burning of wood, which the fire dissipates into smoke and ashes; for not only the latter of these is confessedly made up of

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry. making a ſeparation, cauſes ſo ſtrict an union, that it ſelf alone is unable to diſſolve it; as when an alkaline ſalt, and the terreſtrial reſidue of the aſhes, are incorporated with pure ſand, and by vitrification, made one permanent body, the greeniſh ſort of glaſs, that eludes the greateſt violence of the fire. I have ſome pieces of glaſs, which I ſaw flow down from an earthen crucible, expos'd for a good while with ſilver in it, to a very vehement fire. And thoſe, who deal much in the fuſion of metals, inform me, that the melting of a great part of a crucible, is no great wonder in their furnaces. I remember I have obſerv'd too, in the melting of great quantities of iron out of ore, by the help of charcoal, that by the prodigious vehemence of the fire, part of the materials expos'd, was, inſtead of being analyz'd, fuſed, and turn'd into a dark, ſolid, and very ponderous glaſs; and this happens in ſuch quantities, that in ſome places, I have ſeen, the very high ways, near ſome iron-works, mended with ſuch lumps of glaſs. I have alſo obſerv'd, that ſome kind of fire-ſtone it ſelf, having been employ'd in furnaces, where it was expos'd to very ſtrong, and laſting fires, has had all its fix'd parts ſo wrought on thereby, as to be perfectly vitrified; as I have try'd, by forcing from it pretty large pieces of perfect, tranſparent glaſs. And to ſhew, that the preceding definition of heat, is not countenanced by that of its contrary quality cold, which is ſaid to aſſociate things homogeneous and heterogeneous; I muſt obſerve, that neither is this definition unqueſtionable: for the union of heterogeneous bodies, ſuppos'd to be the genuine production of cold, is not perform'd by every degree of that quality. We ſee, for inſtance, that when the urine of healthy men, has been ſuffer'd to ſtand for a while, the cold makes a ſeparation of the thinner part from the groſſer, which ſubſides to the bottom, and grows opake there; whereas, if the urinal be made warm, thoſe parts readily mix again, and the whole liquor becomes tranſparent as before. And when by glaciation, wood, ſtraw, duſt, water, *&c.* are ſuppos'd to be united into one lump of ice, the cold does not cauſe any real union of theſe bodies, but only hardening the aqueous parts of the liquor into ice, the other bodies being accidentally preſent in that liquor, are frozen up in it, not really incorporated. And accordingly, if we expoſe a heap of mony, conſiſting of gold, ſilver, and copper coins, or any other bodies of different natures, which are uncapable of congelation, to ever ſo intenſe a degree of cold; we find not they are at all ſo much as compacted thereby, much leſs united together: and even in liquors themſelves, we find phenomena, which induce us to queſtion the definition we are examining. If the authority of *Paracelſus* were a ſufficient proof in matters of this nature, I might here inſiſt on that proceſs of his, whereby he teaches, that the eſſence of wine may be ſtruck to the center, and ſever'd from the phlegm and ignoble part, by the aſſiſtance of congelation.

But

Chymiſtry.

But I dare not lay much ſtreſs upon this proceſs, becauſe I have found, that if it were true, it would be but ſeldom practicable in this country upon the beſt wine; for in our ſharpeſt winters, I cou'd never tolerably freeze a thin vial of canary; and even with ſnow and ſalt, but little deeper than the ſurface: and I ſuppoſe it is not every degree of cold, capable of congealing liquors, which will make ſuch an analyſis of them by ſeparating their aqueous and ſpirituous parts; for I have, ſometimes, ſeverally frozen red wine, urine, and milk, but could not obſerve any ſeparation. And the *Dutch*, who winter'd in *Nova Zembla*, tho' they relate, that there was a ſeparation of parts made in their frozen beer, about the middle of *November*; yet of the freezing of their ſack in *December* following, they only ſay "it was frozen very hard; ſo that when every man was to "have his part, we were forc'd to melt it in the fire." In which words they imply, not that their ſack was divided into different ſubſtances, as their beer had been. But notwithſtanding this, I am of opinion, that even cold may, ſometimes, unite ſimilar, and ſeparate diſſimilar ſubſtances. I once purpoſely caus'd a plant, abounding with ſulphureous and ſpirituous parts, to be boiled in fair water; and having expos'd the decoction to a ſharp north wind, in a very froſty night, I obſerv'd, that the more aqueous parts of it were, by the next morning, turn'd into ice; towards the innermoſt part of which, the more agile and ſpirituous portions, as I then conjectured, having retreated, they there preſerv'd themſelves unfrozen, in the form of a high colour'd liquor; the aqueous and ſpirituous parts having been ſo ſlightly blended in the decoction, that they were eaſily ſeparable by ſuch a degree of cold, as would not have divorc'd the parts of urine or wine, which, by fermentation or digeſtion, are more intimately aſſociated with each other. But the *Dutch*, in *Nova Zembla*, found a barrel of beer ſo frozen, that the ſpirituous part appear'd ſeparated from the yeaſt, whilſt ſome on the outſide of the veſſel was frozen as hard as glue; the other, which was converted to ice, being almoſt inſipid.

And having once purpoſely try'd to freeze ſome beer, that was moderately ſtrong, in glaſs veſſels with ſnow and ſalt, I obſerv'd, that there came out of the neck a certain thick ſubſtance, which, it ſeems, was much better able than the teſt of the liquor, that I found turn'd into ice, to reſiſt the froſt; and which, by its colour and conſiſtence, ſeem'd manifeſtly to be yeaſt. This, I confeſs, ſomewhat ſurpriz'd me; becauſe I could not diſcern by the taſt, or find by enquiry, that the beer was too new, to be very fit for drinking. I might confirm the *Dutchmens* relation, by what lately happen'd to a friend of mine, who complain'd to me, that having brew'd ſome ale in *Holland*, the cold of the winter there, froze it into ice, and left only a ſmall proportion of a very ſtrong and ſpirituous liquor.

SECT. II.

Chymistry.

That some things obtained from a body by fire, were not its proper ingredients.

IT is not so certain, as both chymists and *Aristotelians* imagine, that every seemingly similar, or distinct substance, separated from a body, by the help of the fire, was pre-existent in that substance, as a principle. I do not mean, that any thing is separable from a body by fire, that was not materially pre-existent in it; for it far exceeds the power of meer natural agents, to produce a-new, so much as a single atom of matter, which they can only modify and alter, not create.

Nor do I peremptorily deny, that some things obtain'd by the fire from a mix'd body, may have been more than barely materially pre-existent in it; since there are concretes, which before being expos'd to the fire, shew they abound some with salt, and others with sulphur. It will serve the present purpose, if it appear, that several things, obtain'd from a mix'd body, expos'd to the fire, were not its ingredients before; for then it will be rational to expect, that chymists may deceive themselves and others, in concluding, resolutely and universally, those substances to be the elementary ingredients of bodies, barely separated by the fire, of which it may yet be question'd whether they exist or no.; at least till some other argument than that drawn from the analysis, be produced to resolve the doubt.

I say then, it may, without absurdity, be doubted, whether the different substances obtainable from a concrete dissipated by the fire, were existent in it, in that form (at least, as to their minute parts,) wherein we find them after the analysis, so that the fire only disjoin'd and extricated the corpuscles of one principle from those of another, wherewith they before were blended.

That all compound bodies seem to differ only in some mechanical properties.

Upon this supposition, I shall endeavour to shew, first, that such substances, as chymists call principles, may be produced *de novo*; and secondly, to make it probable, that by the fire we may actually obtain from some mix'd bodies such substances, as were not, in the sense deliver'd, pre-existent in them.

Now, if it be true, as 'tis probable, that compound bodies differ from one another, in nothing but the various textures, resulting from the magnitude, shape, motion, and arrangement of their small parts, it will not be irrational to conceive, that one and the same parcel of universal matter, may, by various alterations and contextures, be brought to deserve the name sometimes of a sulphureous, and sometimes of a terrestrial or aqueous body.

Argued from growth of plants.

About the beginning of *May*, I caus'd my gardener to dig out a convenient quantity of good earth, to dry it well in an oven, to weigh it, to put it in an earthen pot, almost level with the surface

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Chymistry. not shifted, nor renewed; and I chose spring-water, rather than rain-water, because the latter is more discernably a kind of παλιγγενεσία, which, tho' free from grosser mixtures, seems to contain in it, besides the steams of several bodies wandering in the air, a certain spirituous substance, which may be extracted out of it; and is by some mistaken for the spirit of the world embodied.

But *Helmont* avers, that he took 200 pounds of earth, dry'd in an oven; and having put it into an earthen vessel, and moisten'd it with rain-water, planted in it the trunk of a willow tree, of five pound weight; this he water'd, as occasion requir'd, with rain, or with distill'd water; and to keep the adjacent earth from getting into the vessel, he employed a perforated plate of iron. After five years he took out the tree, weigh'd it, and computing the leaves that fell in four autumns, he found it to weigh 169 pounds, and about three ounces. And having again dry'd the earth it grew in, he found it to want of its former weight of 200 pounds, only about two ounces; so that 164 pounds of the roots, wood, and bark, which constituted the tree, seem to have sprung from the water. And, doubtless, if *Helmont* had made any analysis of this plant, as I did of one of my plants, fed only with fair water, it would have afforded him the like distinct substances, as another vegetable of the same kind.

And water being the principle of all things.

Helmont, we know too, asserts, that all mix'd bodies spring from one element; and that vegetables, animals, marcasites, stones, metals, &c. are materially but simple water, disguiz'd into these various forms by the plastic virtue of their seeds; and his principal reasons for it seems to be these. 1. The ultimate reduction of mixed bodies into insipid water. 2. The vicissitude of the supposed elements. And, 3. The production of perfectly mix'd bodies out of simple water. And, first, he affirms, that his alkahest adequately resolves plants, animals, and minerals, into one liquor, or more, according to their several internal differences of parts; and that the alkahest being abstracted from these liquors, in the same weight and with virtue, as when it dissolv'd them, the liquors may, by frequent cohobations from chalk, or some other proper matter, be totally depriv'd of their seminal endowments, and return at last to their first matter, insipid water. Otherways he also proposes, to divest some particular bodies of their borrowed shapes, and make them return to their first simplicity. The second topic whence *Helmont* argues water to be the material cause of mixed bodies, is, that the other supposed elements may be transmuted into one another. But the experiments he produces on this occasion are so difficult to be made and judg'd of, that I shall not insist upon them. Besides, if they were granted to be true, his inference from them is somewhat disputable; and as our author in his first argument, endeavours to prove water the sole element of mix'd bodies, by their ultimate resolution, when by his alkahest, or some other conquering agent, the seeds have been worn out, or destroyed, which disguized them; so

in his third argument, he attempts to ſhew the ſame by the conſtitution of bodies; which he aſſerts to be nothing but water ſubdued by ſeminal virtues. Of this he gives various inſtances, as to plants and animals; but ſeveral of them being difficult, either to be made or underſtood, and others of them liable to different exceptions; the inſtance of the willow-tree ſeems the moſt proper to inſiſt on. However, this opinion of his is no new one; tho' the arguments for it may, in great meaſure, be his own. The doctrine is aſcribed to *Thales*, to *Homer*, to *Heſiod*, to *Moſes*, and to the *Phenicians*, who taught, that the earth was made of water; and from them, 'tis ſuppoſed that *Thales* took it.

And tho' *Helmont* produces no inſtance of any mineral body, and ſcarce of any animal, generated of water; yet a *French* chymiſt, M. *de Rochas*, affords us an experiment, which, if it ſucceeded as he delivers it, is very remarkable. "Having," ſays he," found ſurprizing things from the natural operation of water, I was willing to know what might be done with it by art. I therefore took water, which, I knew, was mixed with no other thing than the ſpirit of life; and by a heat artificial, continual, and proportionate, I prepared and diſpoſed it by the graduations of coagulation, congelation, and fixation, till it was turned into earth, which produced animals, vegetables, and minerals. I ſay not what animals, vegetables, and minerals, for that is reſerved for another occaſion; but the animals moved of themſelves, eat, *&c.* and by the anatomy I made of them, I found them compos'd of much ſulphur, little mercury, and leſs ſalt. The minerals began to grow and increaſe, by converting into their own nature one part of the earth thereto diſpoſed; they were ſolid and heavy. And by this truly demonſtrative ſcience, chymiſtry, I found that they were compoſed of much ſalt, little ſulphur, and leſs mercury."

But I have ſome ſuſpicions concerning this ſtrange relation, which make me unwilling to declare an opinion of it; unleſs I were ſatisfied in ſeveral material circumſtances, which our author has left unmentioned: tho' as for the generation of living creatures, both vegetable and ſenſitive, it need not ſeem incredible; ſince we find, that our common water, which is often impregnated with variety of ſeminal principles, long kept in a quiet place, will putrefie; and then too, perhaps, produce moſs and little worms, or other inſects, according to the nature of the ſeeds that were lurking in it. And as *Helmont* gives no inſtance of the production of minerals out of water; ſo the principal argument that he employs, to prove that they, and other bodies may be reſolv'd into water, is drawn from the operations of his alkaheſt, and, conſequently, cannot be ſatisfactorily examined by us.

'Tis, however, ſurprizing to obſerve, how great a ſhare of water goes to make up ſeveral bodies, whoſe forms promiſe nothing near ſo much. Eels, by diſtillation, yielded me ſome oil, ſpirit, and volatile ſalt, beſides the *Caput mortuum*; yet all theſe were ſo diſproportionate

to

Chymistry. to the phlegm, that they seemed to have been nothing but that coagulated; which, likewise, strangely abounds in vipers, tho' they are esteemed very hot in operation, and will, in a convenient air, survive for some days the loss of their heads and hearts. Human blood it self, as spirituous and as elabourate a liquor as 'tis reputed, so abounds in phlegm, that distilling some of it, on purpose to try the experiment; out of about seven ounces and a half, we drew near six ounces of phlegm, before any of the more operative principles began to rise. And, to satisfie my self that some of these animal phlegms were sufficiently destitute of spirit, to deserve their name; I was not content to tast them only, but poured on them acid liquors, to try if they contained any volatile salt or spirit; which would probably have discovered it self, by making an ebullition with the liquor thus employed. And tho' corrosive spirits seem to be nothing else but fluid salts, yet they also abound in water; which may be observed, by entangling, and so fixing their saline part, as to make them corrode some proper body; or else if it be mortified with a contrary salt, as I have very manifestly observed, in making a medicine somewhat like *Helmont*'s *Balsamus Samech*, with distill'd vinegar, instead of spirit of wine, wherewith he prepares it; for of that acid spirit, the salt of tartar, from which it is distill'd, will, by mortifying and retaining the acid salt, turn into worthless phlegm, near twenty times its weight, before it be so fully impregnated, as to rob no more distilled vinegar of its salt. And tho' spirit of wine, exquisitely rectified, seems of all liquors to be the most free from water; yet even this is by *Helmont*, in case what he relates is true, with probability, affirmed to be materially water, under a sulphureous disguize; for, according to him, in making that excellent medicine *Paracelsus*'s *Balsamus Samech*, (which is nothing but *Sal tartari* dulcify'd, by distilling spirit of wine from it, till the salt be sufficiently saturated with its sulphur; and till it suffers the liquor to be drawn off as strong as it was poured on;) when the salt of tartar, from which it is distilled, hath retained, or deprived it of the sulphureous parts of the spirit of wine; the rest, which is incomparably the greater part of the liquor, will turn to phlegm. But I have not as yet sufficiently tried the thing my self: however, something of experiment keeps me from thinking it absurd; tho' I in vain try'd it with ordinary salt of tartar: for *Helmont* not only often relates it, and draws consequences from it, but a person noted for his veracity, and skill in chymistry, affirm'd to me, that by preparing the salt and spirit, in a way suitable to my principles, he had made the experiment succeed very well; without adding any thing to the salt and spirit.

I have indeed, sometimes, wondered to see how much phlegm may be obtained from bodies by fire. But supposing the alkahest cou'd reduce all bodies into water; yet whether the water, because insipid, must be elementary, may be doubted: for I remember the candid *Petrus Laurembergius* affirms, he saw an insipid menstruum, that was a powerful dissolvent, even of gold. And the water which may be drawn

from

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry. moſt all the ſea-ſalt that concurr'd to compoſe the ſal-armoniac. And how well the ſea-ſalt was united to the lime, appears from hence, that I have, by making the fire at length very vehement, caus'd both the ingredients to melt, in the retort, into one maſs, apt to grow moiſt in a damp air. If it be here objected, that theſe inſtances are taken from factitious concretes, which are more compounded than natural ones; I reply, it will be difficult to prove, that nature her ſelf does not mix together ſuch bodies as are already compounded of elementary or more ſimple ones. Thus vitriol, for inſtance, tho' I have ſometimes taken it out of the mineral earths, where nature had, without the aſſiſtance of art, prepared it, is really a mix'd body, conſiſting of a terreſtrial ſubſtance of a metal, and alſo of at leaſt one ſaline body of a peculiar, and not elementary nature. And we ſee, alſo, in animals, that their blood may be compos'd of ſeveral very different mix'd bodies; ſince many ſea-fowl taſt rank of the fiſh on which they ordinarily feed. And *Hippocrates* obſerves, that a child may be purg'd by the milk of the nurſe, who has taken elaterium; which argues, that the purging corpuſcles of the medicament concur to make up the milk of the nurſe. And from many vegetables there may, without any addition, be obtain'd glaſs; a body ſurely not pre-exiſtent in them, but produced by the fire. I ſhall only add, that by a certain artificial way of managing quick-ſilver, I can, without addition, ſeparate from it a fourth part of a clear liquor, which, with an ordinary *Peripatetic*, wou'd paſs for water, and which a vulgar chymiſt wou'd take for phlegm; and this, for ought I have yet ſeen or heard, is not reducible into mercury again, and conſequently, is more than a diſguize of it. Now, beſides that ſeveral chymiſts will not allow mercury to have any conſiderable quantity of either of the ignoble ingredients, earth and water; the great ponderouſneſs of quick-ſilver makes it unlikely, that it can contain ſo much water as may thus be obtain'd from it; ſince mercury weighs fourteen times more than water of the ſame bulk. And two friends of mine, the one a phyſician, and the other a mathematician, both of them perſons of unſuſpected credit, have ſolemnly aſſured me, that, after many trials they made to reduce mercury into water, in order to a philoſophical work upon gold; they once, by ſeveral cohobations, reduced a pound of quick-ſilver into almoſt a pound of water; and this without the addition of any other ſubſtance, but only by urging the mercury with a fire, ſkilfully managed. Hence it ſufficiently appears, that the fire may ſometimes as well alter bodies as divide them; and that by its means, we may obtain from a mix'd body what did not pre-exiſt therein. And how are we ſure that phlegm is barely ſeparated, not produced, in other bodies by the action of fire; for, many other mix'd bodies are of a much leſs conſtant, and more alterable nature, than mercury appears to be? If we believe *Helmont*'s relations, the *tria prima*, or three chymical principles, are neither ingenerable, nor incorruptible ſubſtances; ſince by his

his alkaheſt, ſome of them may be produced of bodies that were before of another denomination, and all by the ſame powerful menſtruum, be reduced into inſipid water. *Chymiſtry.*

But here may occur a ſcruple about the nature of mixture. *Ariſtotle*, we know, declares it to be ſuch a mutual penetration, and perfect union of the elements, that there is no portion of the mix'd body, how minute ſoever, which does not contain all and every of the four elements; or in which, all the elements are not. And I remember, he reprehends the mixture taught by the ancients, for too ſlight or groſs, as that wherein the elements were only blended, not united: the ancients, however, tho' they did not all agree what kind of bodies were mix'd; yet they almoſt unanimouſly held, that in a compounded body, tho' the *Miſcibilia* were aſſociated in ſuch ſmall parts, and with ſo much exactneſs, that there was no ſenſible particle of the maſs, but ſeem'd of the ſame nature with the reſt, and with the whole; but as to the inſenſible parcels of matter, whereof the *Miſcibilia* conſiſted, they were ſuppos'd to retain each of them its own nature, being but by appoſition united with the reſt into one body. So that tho', by virtue of this compoſition, the mix'd bodies, perhaps, obtain'd ſeveral new qualities; ſtill the ingredients that compounded it, retaining their own nature, were, by the deſtruction of the compoſition, ſeparable from each other; the minute parts, diſengaged from thoſe of a different nature, and aſſociated with thoſe of their own ſort, returning to fire, earth, or water, as they were before they chanc'd to be ingredients of that compoſition. Thus in a piece of cloth, made of white and black threads interwoven, wherein, tho' the whole appear neither white nor black, but grey; yet each of the white and black threads, that compoſe it, remains what it was before, if they were pull'd aſunder, and ſorted, each colour by its ſelf. *The nature of mixture conſidered.*

Ariſtotle tells us, that if a drop of wine be put into ten thouſand meaſures of water, the wine being overpower'd by ſo vaſt a quantity of water, will be turned into it. But if this doctrine were true, one might hope, by melting a maſs of gold and ſilver, and by but caſting into it lead or antimony, grain after grain, we might, at pleaſure, within a reaſonable compaſs of time, turn what quantity we deſired of the ignoble, into the noble metals. Yet in that operation, which the refiners call quartation, and employ to purify gold, altho' three parts of ſilver be ſo exquiſitely mix'd, by fuſion, with a fourth part of gold, that the reſulting maſs acquires ſeveral new qualities, by virtue of the compoſition; and that there is ſcarce any ſenſible part of it which is not compos'd of both the metals; yet if this mixture be caſt into *Aqua fortis*, the ſilver will be diſſolved therein, and the gold, like a dark or black powder, will fall to the bottom; and either body may be again reduced into ſuch a metal, as it was before; which ſhews, that each retain'd its nature, notwithſtanding its being mix'd *per minima*,

Chymiſtry. *minima*, with the other. We likewiſe ſee, that tho' one part of pure ſilver, be mixed with ten parts, or more, of lead; yet the fire will, upon the cupel, eaſily and perfectly ſeparate them again. And not only in chymical analyſes, a ſeparation is made of the elementary ingredients, but ſome mixed bodies afford a much greater quantity of one particular principle than of another; as turpentine and amber yield much more oil and ſulphur, than water; whilſt wine, which is confeſs'd to be a perfectly mix'd body, affords but a little inflammable ſpirit or ſulphur, and not much more earth; but a vaſt proportion of phlegm, or water; which could not be, if, as the *Peripatetics* ſuppoſe, every minute particle were of the ſame nature with the whole; and conſequently, contained earth and water, air and fire.

But not to conſider thoſe improper mixtures, wherein hornogeneous bodies are join'd, as when water is mix'd with water; proper mixtures ſeem,. in the general, to be but an intimate union of any two or more bodies, of different denominations; as when aſhes and ſand are fuſed into glaſs, or antimony and iron into *Regulus Martis*; when wine is ſhook with water, or ſugar diſſolv'd in the ſame. Now in this general notion of mixture, it does not appear, that the ingredients do, in their ſmall parts, ſo retain their nature, and remain diſtinct in the compound, that they may thence, by the fire, be again taken aſunder. For tho', perhaps, in ſome mixtures of certain permanent bodies, this recovery of the ſame ingredients may be made; yet I am not convinced, that it will generally hold, or that it is deducible from chymical experiments, and the true notion of mixture. But bodies, I preſume, may be mixed, and that very durably, tho' they are not elementary, nor have been reſolved into elements, or principles, in order to it; as is evident in the *Regulus* of fuſed antimony and iron; and in gold coin, which laſts for many ages, whilſt the gold is generally alloy'd by the mixture of a quantity of ſilver, or copper, or of both. And there being but one univerſal matter of all things, the portions of it ſeem to differ from one another, only in certain qualities, or accidents; upon whoſe account the corporeal ſubſtance they belong to, receives its denomination, and is referr'd to ſome particular ſort of bodies; ſo that if it be deprived of thoſe qualities, tho' it ceaſes not to be a body, yet it ceaſes from being that kind of body, as a plant, or an animal, a red, or a green, a ſweet, or a ſour ſubſtance. It alſo frequently happens, that the ſmall parts of bodies cohere together but by immediate contact and reſt; whilſt there are few bodies, whoſe minute parts ſtick ſo cloſe together, but that it is poſſible to meet with ſome other body, whoſe ſmall parts may get between them, and ſo disjoin them; or may be fitted to cohere more ſtrongly with ſome of them, than thoſe do with the reſt; or, at leaſt, may be combined ſo cloſely therewith, that neither the fire, nor the other uſual inſtruments of chymical analyſes, will ſeparate them. . Theſe things conſidered, I cannot peremptorily

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Chymiſtry.

deed, a liquor very piercing, but not at all acid; and different as well in ſmell, and other qualities, as in taſt, from the ſpirit of vinegar; which, likewiſe, ſeem'd to have left ſome of its parts very firmly united to the *Caput mortuum*: and this, tho' of the nature of lead, was in ſmell, colour, *&c.* different from minium. Thus alſo, tho' two powders, the one blue, and the other yellow, may appear a green mixture, whilſt neither of them loſes its own colour, as a good microſcope has ſometimes informed me; yet having mixed minium and ſal-armoniac in a due proportion, and expos'd them in a glaſs-veſſel to the fire, the whole maſs became white, and the red corpuſcles were deſtroyed; for tho' the calcin'd lead was ſeparable from the ſalt, yet it did not part from it in the form of a red powder, ſuch as the minium was, when put to the ſal-armoniac. I leave it, alſo, to be conſidered, whether in blood, and ſeveral other bodies, it be probable, that each of the corpuſcles concurring to make up the compound, always retains its own nature therein; ſo that chymiſts may extricate each ſort of them from all the others, wherewith it contributed to compoſe a body of one denomination.

And ſince the major part of chymiſts allow, what thoſe they call philoſophers affirm of their ſtone; they may pleaſe to conſider, that tho' when common gold and lead are mixed together, the lead may be ſever'd almoſt unalter'd from the gold; yet if, inſtead of gold, a little of the red elixir be mixed with the lead, their union will be ſo indiſſoluble in the perfect gold produced thereby, that there is no known, nor, perhaps, poſſible way of ſeparating the diffus'd elixir from the fix'd lead; but they both conſtitute a moſt permanent body, wherein the lead ſeems quite to have loſt its properties; and to have been rather tranſmuted by the elixir, than aſſociated with it. Hence it ſeems not always neceſſary, that the bodies intimately mixed, ſhould each retain its own nature; ſo as, when the maſs it ſelf is diſſipated by the fire, to be more diſpoſed to appear again in its priſtine form, than in a new one; which it may have acquired by a ſtricter aſſociation of its parts, with thoſe of ſome of the other ingredients of the compoſition, than with one another.

If it be objected, that unleſs the hypotheſis I oppoſe, be admitted, in ſuch caſes as we have mentioned, there would not be an union, but a deſtruction of the mix'd bodies; which ſeems all one as to ſay, that of ſuch bodies there is no mixture at all: I anſwer, that tho' the mix'd ſubſtances remain, whilſt only their accidents are deſtroyed; and tho' we may call them ingredients, becauſe they were diſtinct bodies before they were put together; yet they are afterwards ſo confounded, that I ſhall rather call them concretions, or reſulting bodies, than mix'd ones.

If it be alſo ſaid, that this notion of mixture, tho' it may be allow'd when bodies already compounded are put to be mix'd; yet it is not applicable to thoſe mixtures, that are immediately made of the ele-

ments, or principles themſelves: I reply, that I here conſider the nature of mixture, ſomewhat more generally than the chymiſts; who yet cannot deny, that there often are mixtures, and thoſe very durable ones, made of bodies not elementary. And farther; tho' it may be probably pretended, that in thoſe mixtures, made immediately of the bodies called principles or elements, the mix'd ingredients may better retain their own nature in the compound maſs, and be more eaſily ſeparated from thence; yet beſides that it may be doubted, whether there are any ſuch primary bodies, I ſee not why the reaſon I alledg'd, of the deſtructibility of the ingredients of bodies in general, may not, ſometimes, be applicable to ſalt, ſulphur, or mercury; till it be ſhewn upon what account we are to own them priviledg'd. *Chymiſtry.*

But to return from whence this conſideration of mixture has carry'd us. We have ſeen, by the different ſubſtances obtained from a plant, *&c.* nouriſhed only with water, that it was not neceſſary nature ſhould always compound a body, originally, of all ſuch different bodies, as the fire could afterwards make it afford. But this is not all that may be collected from thoſe experiments. There ſeems, alſo, ſomething deducible from them, that ſubverts another foundation of the chymical doctrine. For ſince out of fair water alone, not only ſpirit, but ſalt, oil, and earth, may be produced, it follows, that ſalt and ſulphur are not primogeneal bodies and principles; ſince they are every day made out of plain water, by the texture which the ſeed, or ſeminal principle of plants, gives it. And this would not, perhaps, ſeem ſo ſtrange, did we not overlook the obvious and familiar operations of nature; for if we conſider what ſlight qualities they are that ſerve to denominate one of the *tria prima*; we ſhall find that nature frequently produces as great alterations in ſeveral parcels of matter. To be readily diſſoluble in water, is enough to make a body paſs for a ſalt; yet I ſee not why, from a new arrangement and diſpoſition of the component particles, it ſhould be much harder for nature to compoſe a body diſſoluble in water, of a portion of matter that was not ſo before; than of the liquid ſubſtance of an egg, which will eaſily mix with water, to produce, by the bare warmth of the brooding hen, membranes, feathers, tendons, *&c.* not diſſoluble in water. Nor is the hardneſs and brittleneſs of ſalt, more difficult for nature to introduce into ſuch a yielding body as water, than it is for her to form the bones of a chick, out of the tender ſubſtance of the liquors of an egg. But I eaſily foreſee it will be alledg'd, that the former examples are all taken from plants and animals, wherein the matter is faſhioned by the plaſtic power of the ſeed, or ſomething analogous thereto; whereas the fire does not act like any of the ſeminal principles, but deſtroys them all, when they come within its reach. To this I need only ſay, that whether it be a ſeminal principle, or any other, which faſhions the matter, after thoſe various manners I have mention'd; 'tis evident, that either by the plaſtic

power

Chymiſtry. power alone, or that and heat together, or by ſome other cauſe, capable of giving a texture to the matter; it is yet poſſible that it may be a-new contriv'd into ſuch bodies.

And thus much, I preſume, will ſuffice to ſhew, that a conſidering man may very well queſtion the truth of thoſe ſuppoſitions which chymiſts and the *Peripatetics*, without proof, take for granted; and upon which depends the validity of the inferences they draw from their experiments.

SECT. III.

I Proceed now to conſider the experiments themſelves, wherein our opponents uſually triumph and glory. And theſe will the rather deſerve a ſerious examination; becauſe thoſe who alledge them, do it with ſo much confidence and oſtentation, that they have hitherto impos'd upon almoſt all perſons, without excepting philoſophers and phyſicians themſelves, who have read their books, or heard them talk. For ſome learned men have been content rather to believe what theſe ſo boldly affirm, than be at the trouble and charge to try whether it were true or no. Others again, who have curioſity enough to examine the truth of what is averr'd, want ſkill and opportunity to do what they deſire; whilſt the generality, even of ſenſible men, ſeeing the chymiſts actually perform many ſtrange things, and, among others, reſolve compound bodies into ſeveral ſubſtances, not known by former philoſophers to be contained in them; and hearing with what confidence chymiſts aver the ſubſtances, thus obtain'd from compound bodies, by the fire, to be true elements or hypoſtatical principles of them, they are forward to think it but juſt to credit the ſkilful artiſts in their own art; eſpecially when thoſe things, whoſe nature they ſo confidently take upon them to teach others, are productions of their own ſkill, and ſuch as others know not what to make of.

But we muſt not ſuffer our ſelves to be impos'd upon by hard names or bold aſſertions; nor to be dazled with that light which ſhou'd but aſſiſt us to diſcern things the more clearly. To help in the production of bodies, is not to underſtand by them. Thus men, for being fathers of children, are not the better acquainted with the number and nature of the parts that conſtitute a child's body.

No preciſe number of elements fixt. It does not appear, that three is preciſely and univerſally the number of the diſtinct ſubſtances or elements, into which all mix'd bodies are reſoluble by fire.

If it be granted, that the elements, at firſt, conſiſted of certain ſmall primary coalitions of the minute particles of matter into corpuſcles, very numerous, and very like each other; it will not be abſurd to con-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymistry. tryals is, not that they are chargeable, but unsatisfactory, tho' they should succeed. For the extraction of this golden salt, being, in chymical processes, prescribed to be obtain'd by corrosive menstrua, or the intervention of other saline bodies; it will remain doubtful, whether the salt produc'd be that of gold it self, or of the saline bodies or spirits, employed to prepare it; for that such disguizes of metals often impose upon artists, is no new thing in chymistry. I would, likewise, willingly see the three principles separated from the pure sort of virgin-sand, from osteocolla, from refined silver, from pure quick-silver, and from *Venetian* talc; which latter, by long detention in an extreme reverberatory heat, I cou'd but divide into smaller particles, not the constituent principles. Nay, when I caus'd it to be very long kept in a glass-house fire, it came out in the figure its lumps had, when put in; tho' alter'd to an almost amethystine colour. I dare not, indeed, absolutely affirm it impossible to analyze these bodies into their *tria prima*; yet because neither my own experiments, nor any competent testimony hath hitherto either taught me how such an analysis may be, or satisfied me that it hath been made; I must take the liberty to doubt, till the chymists prove it, or give us intelligible and practicable processes to perform what they pretend. For whilst they affect that enigmatical obscurity, with which they puzzle the readers of their processes, concerning the analytical preparation of gold or mercury; they leave wary persons much unsatisfied, whether or no the different substances, they promise to produce, be truly the hypostatical principle, or only some intermixtures of the divided bodies, with those employ'd to work upon them; as is evident in the seeming crystals of silver, and those of mercury; which, tho' by some, inconsiderately supposed to be the salts of those metals, are plainly but mixtures of the metalline bodies, with the saline parts of *Aqua fortis*, or other corrosive liquors; as is evident by their being reducible into what they were before.

And I cannot but confess, I have often wonder'd that chymists should so confidently pretend to resolve all metalline and other mineral bodies into salt, sulphur, and mercury. For 'tis a saying almost proverbial among the adept; and the famous *Roger Bacon* has particularly adopted it; that 'tis easier to make gold, than to destroy it. And I fear that gold is not the only mineral from which chymists, in vain, attempt to separate their three principles. I know, indeed, the learned *Sennertus* says, "there is salt and sulphur contain'd in all mix'd bo-
"dies; and 'tis well known that skilful chymists can extract them
"thence;" but, by his favour, I must see very good proof, before I can believe such bold general assertions: and he who wou'd convince me of their truth, must first teach me some real practicable way of separating salt and sulphur from gold, silver, and those many different sorts of stones, that a violent fire brings to fusion. And not only I, for my own part, never saw any of the bodies, just mention'd, so re-

resolv'd; but *Helmont* himself declares the same of sand, flint, and some stones. Nay, *Quercetan*, tho' a grand stickler for the *tria prima*, confesses, that diamonds are irresoluble. And as for metalline mercuries, I remember a famous and ingenious artist, who had long been chymist to a great monarch, assured me, he had never really extracted a true and running mercury out of metals; nor had seen it done by any man else. And tho' gold is of all metals that, whose mercury the chymists have most endeavoured to extract, and which they the most boast themselves to have extracted; yet the experienced *Angelus Sala* avers the thing impossible: he adds, that himself had seen much labour in vain bestowed upon that design; and that he had often seen the tricks and impostures of cheating alchymists detected in this affair. But the greatest part of those who are fond of such *Charlatans*, being unskilful, or credulous, or both; 'tis very easy for such as have some skill, much craft, more boldness, and no conscience, to impose upon them; and, therefore, tho' many profess'd chymists, and persons of quality, have told me, that they have made, or seen the mercury of gold, or of some other metal; yet I have been still apt to fear, that either these persons have had a design to deceive others, or have not had skill and circumspection enough to keep themselves from being deceived.

To make a shew of producing a metalline mercury.

I once devised an experiment, innocently to deceive some persons, and let them see how little is to be built upon the affirmation of those, who are either unskilful, or unwary, when they tell us, they have seen chymists make the mercury of a metal: and to render this the more evident, I made my experiment much more slight, short, and simple, than are the chymists usual poceſſes to extract metalline mercuries; their operations being commonly more elaborate and intricate, and by requiring a much longer time, give the alchymist a greater opportunity to cozen. And, to make my experiment look the more like a true analysis, I not only pretend, as well as others, to extract a mercury from the metal I work upon; but likewise to separate a large proportion of manifest and inflammable sulphur. I take, then, the filings of copper, common sublimate powder'd, and sal-armoniac, of each about a dram or two; and these being well mix'd together, I put them into a glass urinal; which (having first stopp'd it with cotton), to avoid the noxious fumes, I approach, by degrees, to a competent fire of well-kindled coals, or to the flame of a candle; and, after a while, the bottom of the glass being held just upon the kindled coals, or in the flame; you may, in about a quarter of an hour, or less, perceive in the bottom of the glass some running mercury; and if you then take away the glass, and break it, you shall find a parcel of quick-silver, perhaps altogether, or perhaps part of it only, in the pores of the solid mass. You will find too, that the remaining lump being held to the flame of the candle, will readily burn with a greenish flame, and soon after acquire in

Chymistry. the air a greenish blue; which being the colour ascribed to copper, when its body is unlock'd, 'tis easy to persuade men, that this is the true sulphur of that metal; especially since not only the salts may be suppos'd to be flown away, or sublimed to the upper part of the glass, whose inside will commonly appear whitened by them; but the metal seems to be quite destroyed; the copper no longer appearing in a metalline form, but almost in that of a resinous lump. The case, however, is only this; the saline parts of the sublimate, together with the sal-armoniac, excited and actuated by the vehement heat, fall upon the copper, whereby the small parts of the mercury being freed from the salts that kept them asunder, and by the heat tos's'd up and down, convene after many occursions, into a conspicuous mass of liquor: and as for the salts, some of the more volatile of them subliming, the others corrode the copper, and uniting themselves with it, strangely alter, and disguize its metalline form, and therewith compose a new kind of concrete, inflammable like sulphur.

More than three principles afforded by same bodies.

But to proceed; as there are some bodies which yield not so many as three principles; so there are many others, that, in their resolution, exhibit more. From our doctrine of the primary association of the small particles of matter, it seems probable, that of such elementary corpuscles, there may be more sorts than three, or four, or five. And if corpuscles of a compound nature, may, in all the usual examples of chymists, pass for elementary; it seems not impossible, that as *Aqua fortis*, or *Aqua regia*, will make a separation of dissolv'd silver and gold, tho' the fire cannot; so there may be some agent found so subtile and powerful, at least in respect of those particular compound corpuscles, as to be able to resolve them into the more simple ones, whereof they consist; and, consequently, increase the number of the distinct substances, whereinto the mix'd body has been hitherto thought resoluble. And if that be true we formerly mention'd, of *Helmont*'s alkahest, which divides bodies into other distinct substances, both as to number and nature, than doth the fire; it will greatly countenance my conjecture. But confining ourselves to such ways of analizing mix'd bodies, as are already known to chymists; it may, without absurdity, be question'd, whether, besides those grosser elements of bodies, which they call salt, sulphur, and mercury, there may not be ingredients of a more subtile nature; which being extremely small, and not in themselves visible, may escape unheeded, at the junctures of the vessels employed in distillation. For we may well suspect there are several sorts of bodies, not immediate objects of any of our senses; since we see, that not only those little corpuscles, which issue out of the load-stone, produce surprizing effects; but the effluvia of amber, jet, and other electrical concretes, tho', by their operations upon the particular bodies, dispos'd to receive their action, they seem to fall under the

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Chymistry. dangerous sedition of the hands and legs, and other more busie parts of the body, against the seemingly unactive stomach. In a word, since earth and water appear as clearly and as generally as the other principles, upon the resolution of bodies, to be ingredients therein; and since they are useful, if not immediately to us, to the bodies they constitute; to exclude them out of the number of elements, is not to imitate nature.

Earth and water to be reckoned among the chymical principles.

And here I cannot but take notice, that the great argument which the chymists employ to debase earth and water, and make them look'd upon as useless and unworthy to be reckon'd among the principles of mix'd bodies, is, that they are not endowed with specific properties, but only with elementary qualities; of which they speak very slightly, as of qualities contemptible and unactive: but I see no sufficient reason for this practice; since heat is confess'd to be an elementary quality; for, that numerous considerable things are performed by it, is manifest to those who duly consider the various phenomena, wherein it intervenes as a principal actor: and almost all the operations and productions of chymists are perform'd and obtain'd chiefly by its means. And as for cold it self, upon whose account they so despise the earth and water; if they please to read in the history of the voyages of our *English* and *Dutch* navigators to *Nova Zembla*, and other northern regions, what stupendous things may be effected by cold; they would not, perhaps, think it so despicable. The conservation of the texture of many bodies, both animate and inanimate, so greatly depends upon the convenient motion, both of their own fluid and looser parts, and of the bodies which surround them, that we see not only the animal œconomy frequently disordered by the immoderate or unseasonable coldness of the air; but the solid and durable body of iron it self; for if you take a slender piece of steel, and after having brought it in the fire to a white heat, suffer it afterwards to cool leisurely in the air, it will, when cold, be much of the same hardness it was of before; but if, as soon as you remove it from the fire, you plunge it into cold water, it will, upon the sudden refrigeration, acquire a much greater hardness, and become manifestly brittle. And to shew, that this is not owing to any peculiar quality in the water, or other liquor, or unctuous matter, wherein such heated steel is usually quenched, that it may be temper'd; I know a very skilful tradesman who frequently harden'd steel, by suddenly cooling it in a body that is neither a liquor, nor so much as moist. Hence it appears, that water is not always so inefficacious and contemptible a body as our chymists would have it pass for.

And at least one certain alkaline, if not also an acid, spirit.

But tho' I think it evident, that earth and phlegm are to be reckon'd among the elements of most animal and vegetable bodies; yet it is not upon this account that I suppose several bodies resoluble into more substances than three. For there are two experiments, which I have sometimes made, to shew, that, at least, some mix'd bodies are di-

divisible into more distinct substances than five. Out of two distill'd liquors, which pass for elements of the body, whence they are drawn. I can, without addition, make a true yellow and inflammable sulphur, tho' the two liquors remain afterwards distinct; and having long observed, that by the distillation of several woods, both in ordinary and in some unusual sorts of vessels, the spirits that came over, in plenty, had, besides a strong taste, to be met with in the empyreumatical spirits of many other bodies, an acidity almost like that of vinegar; I suspected, that tho' the sourish liquor, distill'd from box-wood, for instance, be look'd upon by chymists as barely the spirit of it; and therefore as one single element or principle, does yet really consist of two different substances, and may be divided into them; and consequently that such wood, and other mix'd bodies as abound with such a vinegar, may be said to consist of one element or principle more than the chymists are yet aware of. I, therefore, distilled a quantity of box-wood *per se*, and slowly rectified the sourish spirit, the better to free it both from oil and phlegm; then cast into this rectified liquor a convenient quantity of powder'd coral, expecting that the acid part of the liquor wou'd corrode it, and being associated therewith, be so retained by it, that the part of the liquor, which was not of an acid nature, nor fit to fasten upon the coral, would be permitted to ascend alone. And, accordingly, having gently abstracted the liquor from the coral, there came over a spirit of a strong smell, and of a very piercing taste, but without any sourness; and which was, in several qualities, manifestly different, not only from a spirit of vinegar, but from some spirit of the same wood, that I purposely kept by me, without depriving it of its acid ingredient. This sour spirit of box would not only, as I just said, dissolve corals, which the other would not fasten on; but being poured upon salt of tartar, would immediately boil and hiss, tho' the other would lie quietly upon it. The acid spirit poured upon minium, made a sugar of lead, which I did not find the other to do; some drops of this penetrating spirit being poured upon a few drops of syrup of violets, seem'd rather to dilute than otherwise alter the colour; whereas the acid spirit turn'd the syrup reddish, and wou'd probably have made it of as pure a red as acid salts usually do, had not the operation been hinder'd by the other spirit. A few drops of the compound spirit, shaken into a large quantity of the infusion of *Lignum nephriticum*, presently destroy'd all its bluish colour; whilst the other spirit wou'd suffer it to remain: and having pour'd fair water upon the coral that remain'd in the bottom of the glass, wherein I had rectified the double spirit, first drawn from the box; I found that the acid spirit had really dissolv'd and coagulated with the coral. For by the effusion of fair water, I obtain'd a solution, which was red; whence the water being evaporated, there remain'd a soluble substance much like the salt of coral; as chymists call that magistery of it, which they make by dissolving it in common spirit of vinegar, and ab-

Chymiſtry. abſtracting the menſtruum *ad ſiccitatem.* The ſimple ſpirit of box, if chymiſts will have it therefore ſaline, becauſe it has a ſtrong taſt, furniſhes us with a new kind of ſaline bodies, different from thoſe hitherto taken notice of. For tho' of the three chief ſorts of ſalts, the acid, the alkaline, and the ſulphureous, there is no one that ſeems to be at amity with both the other two; yet I did not find but that the ſimple ſpirit of box agreed very well both with the acid and other ſalts. For tho' it wou'd lie very quiet with ſalt of tartar, ſpirit of urine, and other bodies, whoſe ſalts were either of an alkaline or fugitive nature; yet did not oil of vitriol it ſelf produce any hiſſing or effervеſcence with it.

This experiment teaches us a method whereby we may prepare various ſorts of new ſpirits, which, tho' more ſimple than any ſuppoſed elementary, are manifeſtly endowed with peculiar and powerful qualities; ſome of which may, probably, be of conſiderable uſe in phyſic, as well alone, as aſſociated with other things; as may be gueſſed by the redneſs of that ſolution, the ſour ſpirit made of coral, *&c.* and, perhaps, we may here, with the ſame ſucceſs, uſe other alkaline bodies, inſtead of coral. From hence, however, I infer, that there are many compound bodies which may be reſolved into four ſuch different ſubſtances, which merit the name of principles, as well as thoſe to which the chymiſts freely allow it. For ſince they ſcruple not to reckon, that which I call the compound ſpirit of box, for the ſpirit; or as others would have it, the mercury of that wood; I ſee not why the acid liquor, and the other, ſhou'd not each of them, eſpecially the latter, be look'd upon as more deſerving to be called an elementary principle; ſince it muſt needs be of a more ſimple nature than the liquor which was found to be deviſible into that and the acid ſpirit. This further uſe may be alſo made of our experiment; to give us a ſuſpicion, that ſince a liquor, reputed by the chymiſts to be, without diſpute, homogeneous, is, by ſo ſlight a way, diviſible into two diſtinct and more ſimple ingredients; ſome more ſkilful or happier expedient may be found, either further to divide one of theſe ſpirits, or to reſolve ſome, at leaſt, of thoſe other ingredients of mixed bodies, that have hitherto paſs'd, among chymiſts, for their elements and principles.

SECT. IV.

The ambiguity of chymical writers conſider'd.

HAVING thus diſpatch'd what we had to ſay, as to the number of the diſtinct ſubſtances ſeparable from mixed bodies by the fire, I come to conſider the nature of them; and to ſhew, that tho' they ſeem homogeneous bodies, yet they have not the purity and ſim-

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it, be ſuch myſteries, as they would have the world believe; they may write intelligibly and clearly of the principles of mix'd bodies in general, without diſcovering what they call the great work. In ſhort, I could wiſh, that learned men would conſpire together to make theſe deluding writers ſenſible, they muſt no longer hope, with impunity to abuſe the world. For whilſt they are quietly permitted to publiſh books with promiſing titles, and therein to aſſert what they pleaſe, and contradict others, and even themſelves, with as little danger of being confuted, as of being underſtood; they are encouraged to raiſe themſelves a name, by playing upon their readers; who are only the ignorant and credulous, and always admire moſt what they leaſt underſtand. But if judicious men, ſkill'd in chymical affairs, ſhall once agree to write clearly and plainly of them, and thereby keep others from being impos'd upon by dark, empty words; 'tis to be hoped, that theſe obſcure authors, finding that they can no longer write impertinently and abſurdly, without being laugh'd at for it, will be reduced either to write nothing, or books that may teach us ſomething.

Bodies ſeemingly homogeneous, not elementary.

However, that which I am now entering upon, being the conſideration of the things themſelves, into which chymiſts reſolve mixed bodies by the fire; if I can ſhew that theſe are not of an elementary nature, it will be no great matter what names particular chymiſts have been pleas'd to give them.

I ſay then, that as generally as chymiſts appeal to experience, and as confidently as they alledge the ſeveral ſubſtances ſeparated by the fire from a mixed body, for a ſufficient proof of their being its component elements, yet thoſe different ſubſtances are, many of them, far from an elementary ſimplicity, and may be ſtill look'd upon as mixed bodies: the greater part of them alſo retaining the nature of thoſe concretes, whence they were forced.

But before I deſcend to particulars, I think it convenient to obſerve, firſt, that *Helmont* mentions it as a notable thing; and I take it to be a very conſiderable one; that tho' the diſtill'd oil of oil-olive, drawn *per ſe*, is, as I have try'd, of a very ſharp and fretting quality, and of an odious taſt; he tells us, that ſimple oil being only digeſted with *Paracelſus*'s *Sal circulatum*, is reduced into diſſimilar parts, and yields a ſweet oil, very different from the diſtill'd oil; as alſo, that, by the ſame way, there may be ſeparated from wine, a very ſweet and gentle ſpirit, partaking of a far different and nobler quality, than that which is immediately drawn by diſtillation, and call'd dephlegmed *Aqua vitæ*; from whoſe acrimony this other ſpirit is exceedingly remote, altho' the *Sal circulatum*, that makes theſe analyſes be ſeparated from the analyz'd bodies, in the ſame weight, and with the ſame qualities it had before. This affirmation of *Helmont* if we admit for true, we muſt acknowledge, that there may be a very great diſparity betwixt ſubſtances of the ſame denomination, ſeparable from

compound bodies, for beſides the differences I ſhall hereafter take notice of, betwixt thoſe diſtilled oils that are commonly known to chymiſts; it appears from hence, that by means of the *Sal circulatum*, there is quite another ſort of oils, obtainable from the ſame body: and who knows that there are not other agents in nature, by whoſe help there may, whether by tranſmutation, or otherwiſe, be obtained from the bodies vulgarly called mixed, oils, or other ſubſtances, different from thoſe of the ſame denomination, known either to vulgar chymiſts, or even to *Helmont* himſelf?

Secondly, if the opinion of *Leucippus*, *Democritus*, and other ancient and modern philoſophers, be true, that our culinary fire, ſuch as chymiſts uſe, conſiſts of numberleſs little bodies in ſwift motion, which by their ſmallneſs and rapidity are able to penetrate the moſt ſolid and compact bodies; it will be reaſonable to ſuppoſe, that multitudes of theſe fiery corpuſcles, getting in at the pores of the containing glaſs, may aſſociate themſelves with the parts of the mix'd body whereon they work, and with them conſtitute new kinds of compounds, according to the ſhape, ſize, and other properties of the parts of the diſſipated body, happen to diſpoſe them, with regard to ſuch combinations. And of theſe, alſo, there may be the greater number, if we grant that ſuch corpuſcles of the fire are not all of the ſame magnitude or figure. And, indeed, ſome particular experiments have induced me to think, that the particles of an open fire, working upon ſome bodies, may really aſſociate themſelves therewith, and add to their quantity *. Tho' I am not ſure, when it operates on bodies included in glaſs veſſels, that the fiery corpuſcles actually paſs thro' the ſubſtance of the glaſs.

But there are ſome bodies, as gold and ſilver, which do not, in the uſual examinations made by fire, diſcover themſelves to be mix'd: and, if a re-compound body be ſeparable into ſeveral ſubſtances by the fire, it may be reſolved into ſuch as are neither elementary, nor ſuch as it was upon its laſt mixture compoſed of; but into new kinds of mixtures. Of this I have already produced ſome examples in ſoap, ſugar of lead, and vitriol. Now, if we conſider, that there are ſome bodies, as well natural as factitious, manifeſtly re-compounded; that in the bowels of the earth nature may, as we ſee ſhe ſometimes does, make ſtrange mixtures; that ſome animals are nouriſhed with others, and ſome with plants; and that theſe have their nutriment and growth, either from a certain nitrous juice harbour'd in the pores of the earth; or from the excrements

* The ſun's rays will inſinuate themſelves into bodies, ſo as greatly to increaſe their weight. M. *Homberg*, by expoſing four ounces of *Regulus Martis* in powder, at the diſtance of about a foot aud a half from the focus of the duke of *Orlean*'s large burning-glaſs, found it, after an hour's ſtay there, augmented by about $\frac{1}{10}$ upon the balance; notwithſtanding what was diſſipated in ſmoke. *French Memoirs*, A. 1705. p. 125.

Chymiſtry. of animals; or from the putrefied bodies, either of living creatures, or vegetables: or from other ſubſtances of a compound nature: if, I ſay, we conſider this, it may ſeem probable, that there are among the works of nature, a greater number of re-compound bodies, than men uſually take notice of. And, indeed, as I have formerly, alſo, obſerved, it does not appear, that all mixtures muſt be of elementary bodies; but it ſeems far more probable, that there are ſeveral ſorts of compounds, even in regard of their ingredients, conſider'd antecedently to their mixture. For tho' ſome ſeem to be made up by the immediate coalitions of the elements, or principles themſelves, and may therefore be called *miſta primaria*; yet, it ſeems, that many other bodies are mixed at the ſecond hand; their immediate ingredients not being elementary. And from many of theſe ſecondary ſorts of mix'd bodies, may reſult, by a farther compoſition, a third ſort, and ſo onwards. Nor is it improbable, that ſome bodies are made up of mix'd ones, not all of the ſame order; as for inſtance, a concrete may conſiſt of ingredients, whereof the one may have been a primary, the other a ſecondary mix'd body; (as I have in native cinnabar found a courſer part, that ſeems more probably to be ore, a combuſtible ſulphur, and a running mercury;) or, perhaps, without any ingredient of this latter ſort, it may be compos'd of mix'd bodies, ſome of them of the firſt, and ſome of the third kind. And this may be illuſtrated, by reflecting upon what happens in the chymical preparations, of ſome of thoſe medicines called *Bezoardica*. For firſt, from antimony and iron, which may be look'd upon as *prima miſta*, they compound a ſtarry regulus; to which they put, according to their intention, either gold or ſilver; and this makes with it a new and further compoſition. Then they add ſublimate, which is it ſelf a re-compounded body; and from this ſublimate, and the other metalline mixtures, draw a liquor; which may be allowed to be of a yet more compounded nature; if it be true, as chymiſts affirm, that by this art ſome of the gold or ſilver mix'd with the regulus, may be carried over the helm with it, by the ſublimate; as indeed a ſkilful and candid perſon complained to me a while ſince, that a friend of his, and mine, having, by ſuch a way, brought over a great deal of gold, in hopes to do ſomething further with it, which might be gainful to him; has not only miſs'd of his aim, but is unable to recover the volatiliz'd gold, out of the antimonial butter wherewith it is ſtrictly united.

Now, if a compound body conſiſt of ingredients not merely elementary; it is eaſy to conceive, that the ſubſtances into which the fire diſſolves it, tho' ſeemingly homogeneous, may be of a compound nature; thoſe parts of each body that are moſt of kin, aſſociating themſelves into a compound of a new kind. Thus when, for example, I have caus'd vitriol, ſal-armoniac, and ſalt-petre, to be mingled and diſtill'd together, the liquor that came over did not manifeſt it ſelf

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Chymiſtry. tho' they aſcend in cloſe veſſels; and 'twas in ſtopped glaſſes that I raiſed the whole body of camphire. It may be objected, indeed, that theſe examples are of bodies forc'd up in a dry, not a fluid form, like the liquors obtain'd by diſtillation. But 'tis poſſible a body may be chang'd from ſolid to fluid, or from fluid to ſolid, without being otherwiſe much alter'd; as appears by the readineſs wherewith, in winter, the ſame individual ſubſtance is hardened into brittle ice, and thaw'd again into fluid water. Beſides this, common quick-ſilver it ſelf, which the moſt eminent chymiſts confeſs to be a mix'd body, may be driven over the helm in its priſtine form, and conſequently in that of a liquor. And certainly 'tis poſſible, that very compounded bodies may concur to conſtitute liquors; for I have found it poſſible, by the help of a certain menſtruum, to diſtil gold it ſelf thro' a retort, even with a moderate fire. And butter of antimony, if carefully rectified, may be reduced into a very clear liquor; yet when a quantity of fair water is thrown upon it, there will quickly precipitate a ponderous emetic calx, which before made a conſiderable part of the liquor, and is indeed, an antimonial body, carried over and kept diſſolved by the ſalts of the ſublimate; and conſequently a compounded one, as appears from examining this white powder by a ſkilful reduction. And to ſhew, that bodies, as compounded as the flours of brimſtone, may concur to conſtitute diſtill'd liquors; which a mix'd body may be brought over the helm without corroſive ſalts; I have ways of bringing over flours of brimſtone, and perhaps even mineral ſulphurs, wherein I employ none but oleaginous bodies to make volatile liquors; in which not only the colour, but the ſmell, and ſome operations, manifeſt, there is brought over a ſulphur that makes part of the liquor.

And here we ought, again, to remember, that the qualities or accidents, upon account whereof chymiſts call a portion of matter by the name of one of their principles, are not ſuch, but that as great may be produced by the changes of texture, and other alterations, which the fire makes in the ſmall parts of a body. I have already prov'd, by what happens to plants, fed only with fair water, that by changing the diſpoſition of the component parts of a body, nature is able to effect as great changes in a parcel of matter, reputed ſimilar, as thoſe requiſite to denominate one of the *tria prima*. And tho' *Helmont* calls the fire, the artificial death of things; and altho' it has been ſuppoſed, that fire can never generate any thing but fire; yet we ought to conſider, how many new ſorts of mix'd bodies chymiſts themſelves have produced by means of the fire; and particularly that glaſs is not only produced by the manifeſt action of the fire, but has never, for ought we know, been produced any other way. And indeed it ſeems but an inconſiderate aſſertion of ſome *Helmontians*, that every ſort of body, of a peculiar denomination, muſt be produced by ſome ſeminal power. Nor need it much move us, that there are ſome, who look upon whatſoever the fire is employ'd to produce not as natural,

but artificial bodies. For there is not always ſuch a difference, as many imagine, betwixt the one and the other; and it is not ſo eaſie as they think, clearly to aſſign what it is, that properly, conſtantly, and ſufficiently diſcriminates them. A thing is commonly term'd artificial, when a parcel of matter is, by the artificer's hand or tools, or both, brought to ſuch a ſhape or form as he deſign'd; whilſt in many of the chymical productions, the effect would be produced, whether the artificer intended it or no; and is often different from what he intended or expected; and the inſtruments employed, are not tools artificially faſhion'd and ſhap'd, like thoſe of tradeſmen, for ſome particular work; but, for the moſt part, agents of nature's own providing; receiving their chief powers of operation from their own nature or texture, not the artificer. The fire is as well a natural agent as ſeed; and the chymiſt, who employs it, only applies natural agents to patients, which, thus brought together, and acting according to their reſpective natures, perform the work themſelves: as fruit is a natural production, tho' the gardener bring and faſten together the ſciens and ſtock, *&c.* But very ſlight qualities may ſerve to denominate a chymical principle. For when they analyze a compound body, by the fire, and obtain a ſubſtance inflammable, that will not mix with water, they preſently call it ſulphur; what comes over ſapid and diſſoluble in water, paſſes for ſalt; and what is fix'd and indiſſoluble in water, that they name earth: and all the volatile ſubſtances they know not what to make of, they call mercury. But that theſe qualities may either be produced otherwiſe than by ſuch as they call ſeminal agents; or may belong to bodies of a compound nature; appears from glaſs made of aſhes, where the ſtrong-taſted alkaline ſalt, joining with the earth, becomes inſipid, and with it conſtitutes a body, which, tho' alſo dry, fix'd, and indiſſoluble in water, is yet manifeſtly a mix'd body, and made ſo by the fire it ſelf. *Helmont* tells us of a way to tranſmute oil of cinnamon, *&c.* wholly into a volatile ſalt, by a bare mixture of its own alkaline ſalt; from whence, if it be true, as I have reaſon to believe, I may argue, that ſince a ſubſtance, that is as well ſaline and volatile as the ſalts of harts-horn, blood, *&c.* which paſs for elementary, is producible by the fire; and ſince this volatile ſalt is really compounded of a chymical oil and a fixed ſalt; the one made volatile by the other, and both aſſociated by the fire; it may well be ſuſpected, that other ſubſtances ariſing from the ſeparation of bodies by the fire, may be new ſorts of mixtures, and conſiſt of ingredients of different natures. Thus, particularly, I have, ſometimes, ſuſpected, that ſince the volatile ſalts of blood, hartſhorn, *&c.* are fugitive, and of an exceeding ſtrong ſmell; either the chymiſts erroneouſly aſcribe all odours to ſulphurs; or that ſuch ſalts conſiſt of ſome oily parts well incorporated with the ſaline ones. And the like conjecture I have, alſo, made as to ſpirit of vinegar; which, tho' the chymiſts think one of the principles of that body; and tho' being an acid ſpirit, it ſeems

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to be much leſs of kin, than volatile ſalts, to ſulphurs; yet not to mention its piercing ſmell, which I know not with what congruity the chymiſts will deduce from ſalt; I wonder they have not taken notice of what their own *Tyrocinium chymicum* teaches, concerning the diſtillation of *Saccharum Saturni*; out of which, *Beguinus* aſſures us, that he diſtill'd, beſides a very fine ſpirit, no leſs than two oils; the one blood-red and ponderous; but the other ſwimming upon the top of the ſpirit, and of a yellow colour. And tho' I remember not, that I have had two diſtinct oils from ſugar of lead; yet that it will, tho' diſtill'd without addition, yield ſome oil, I find by experience. I know the chymiſts will be apt to pretend, that theſe oils are but the volatiliz'd ſulphur of lead, and will, perhaps, argue it from what *Beguinus* relates, that when the diſtillation is ended, you find a *Caput mortuum* extremely black, and good for nothing; as if the body, or at leaſt, the chief part of the metal it ſelf, were, by the diſtillation, carried over the helm. But as *Saccharum Saturni*, is a kind of magiſtery, made only by calcining lead *per ſe*, diſſolving it in diſtill'd vinegar, and cryſtallyzing the ſolution; I found, upon examination, the *Caput mortuum*, ſlighted by *Beguinus*, to be ſo undeſerving the character he gives it, that I venture to ſay, this oil either formerly concurr'd to conſtitute the ſpirit of vinegar, ſo that what paſſes for a chymical principle, may yet be further reſoluble into diſtinct ſubſtances; or that ſome parts of the ſpirit, together with others of the lead, may conſtitute a chymical oil, which, therefore, tho' it paſs for homogeneous, may be a compound body; or at leaſt, that by the action of the diſtill'd vinegar, and the calx of lead, one upon the other, part of the liquor may be tranſmuted from an acid ſpirit into an oil.

Chymiſts muſt, alſo, confeſs, that in the ſpirit of wine perfectly dephlegm'd, or other fermented liquors, that which they call the ſulphur of the concrete, loſes by fermentation, that property of oil, (which the chymiſts likewiſe take to be the true ſulphur of the mixture,) of being immiſcible with water. And if we credit *Helmont*, a pound of the pureſt ſpirit of wine, may barely, by the help of ſalt of tartar, be reſolv'd or tranſmuted into ſcarce half an ounce of ſalt, and as much elementary water, as amounts to the remaining part of the weight. And it may be doubted, whether that fix'd and alkaline ſalt, which is ſo unanimouſly agreed on to be the ſaline principle of incinerated bodies, be not, as 'tis alkaline, a production of the fire. For, tho' the taſt of tartar ſeems to argue, that it contains a ſalt before it be burned; yet that ſalt being very acid, has a quite different taſt from the lixiviate ſalt of calcined tartar. And tho' it be falſly objected againſt the chymiſts, that they obtain all the ſalts they make, by reducing the body they work on into aſhes, with violent fires; yet this volatile ſalt greatly differs from the fix'd alkaline ſalt I ſpeak of, which ſeems not producible by any known way without incineration. 'Tis not unknown to chymiſts, that quick-ſilver may be precipated,

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Chymiſtry. in both caſes, the name is grounded only upon the predominancy of them. This argument indeed is of weight againſt the *Ariſtotelians*, but affects not me, who look upon no body as a true principle or element, that is not perfectly homogeneous; but further reſoluble into any number of diſtinct ſubſtances, how ſmall ſoever. And as for the chymiſts calling a body ſalt, ſulphur, or mercury, upon pretence, that the principle of the ſame is predominant in it; this is an acknowledgment, that theſe productions of the fire are yet compounded bodies; tho' whilſt this is granted, it is affirm'd, that the reputed ſalt, ſulphur, or mercury, principally conſiſts of one body, that deſerves the name of a principle. But how do chymiſts make it appear, that there are any ſuch primitive and ſimple bodies as thoſe we are ſpeaking of, ſince 'tis confeſs'd, that theſe are not ſuch? And if they pretend to prove this aſſertion by reaſon, what becomes of their confident boaſts, that they can convince our eyes, by manifeſtly ſhewing, in any mix'd body, thoſe ſimple ſubſtances they pretend them to be compos'd of?

It may, indeed, be plauſibly repreſented in favour of the chymiſts, that, as 'tis evident much the greater part of any thing they call ſalt, ſulphur, or mercury, is really ſuch; it would be very rigid to deny thoſe ſubſtances the names aſcribed them, only becauſe of ſome ſlight mixture of a different body. But ſince 'tis to experience that they appeal, we muſt not take it for granted, that the diſtill'd oil, for inſtance, of a plant, is chiefly compos'd of the pure principle call'd ſulphur, till they have given us an ocular proof, that there is in that ſort of plant ſuch an homogeneous ſulphur. For, as for the ſpecious argument which is drawn from the reſemblance betwixt the productions of the fire, and the reſpective *Ariſtotelian* elements, or chymical principles, by whoſe names they are called; the queſtion is not, whether there be obtained from mixed bodies, certain ſubſtances, that agree in outward appearance, or in ſome qualities, with quick-ſilver, brimſtone, *&c.* but, whether all bodies, confeſs'd to be perfectly mixed, were compoſed of, and are reſoluble into a determinate number of primary, unmix'd bodies. It will not preſently follow, that becauſe a production of the fire has ſome affinity with the greater maſſes of matter here below, therefore they are of the ſame nature, and deſerve the ſame name; for the chymiſts are not content, that flame ſhould be look'd upon as a parcel of the element of fire, tho' it be hot, dry, and active; becauſe it wants ſome other qualities belonging to the nature of elementary fire. Nor will they ſuffer the *Peripatetics* to call aſhes, or quick-lime, earth, notwithſtanding the great likeneſs between them; becauſe they are not taſtleſs, as elementary earth ought to be: but if it be demanded, what it is that all the chymical analyſes of bodies do prove, if they prove not that they conſiſt of the three principles, into which the fire reſolves them? I anſwer, that ſome mixed bodies, included in cloſe veſſels,

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are reſoluable into ſeveral ſubſtances different in ſome qualities, but principally in conſiſtence; ſo that out of moſt of them may be obtained a fixed ſubſtance; partly ſaline, and partly inſipid; an unctuous liquor, and another fluid, or more, that, without being unctuous, have a manifeſt taſt. Now, if the chymiſts will agree to call the dry and ſapid ſubſtance, ſalt; the unctuous liquor, ſulphur; and the other, mercury; I ſhall not quarrel with them for it. But if they will tell me, that ſalt, ſulphur, and mercury, are ſimple and primary ſubſtances, whereof each mixed body was actually compounded, and which were really in it antecedent to the operation of the fire; they muſt give me leave to doubt, whether their experiments prove all this. And if they will alſo tell me, the ſubſtances their analyſes afford them, are pure and ſimilar, as principles ought to be; they muſt give me leave to credit my own ſenſes, and their own confeſſions, before their bare aſſertions. But as an element, or principle, ought to be perfectly ſimilar and homogeneous; there is no juſt cauſe why I ſhould rather give a body propoſed, the name of any particular element or principle, becauſe it has a reſemblance to it in ſome obvious quality; rather than deny it that name, upon account of ſeveral other qualities wherein it is unlike.

That the chymical principles are diſſimilar in their nature, ſhewn in ſalts.

The chymiſts will not allow to the *Ariſtotelians*, that the ſalt in aſhes ought to be called earth; tho' the ſaline and terreſtrial parts correſpond in weight, in dryneſs, in fixedneſs, and fuſibility; only becauſe the one is ſapid and diſſoluble in water, and the other not: beſides, we ſee that ſapidneſs and volatility denominate the chymiſts mercury or ſpirit; and yet how many bodies may agree in thoſe qualities, and ſtill have very different natures, and numerous diſagreeing qualities? For, not only ſpirit of nitre, *Aqua fortis*, ſpirit of ſalt, oil of vitriol, ſpirit of alum, ſpirit of vinegar, and all ſaline liquors, diſtilled from animal bodies; but all the acetous ſpirits of woods, freed from their vinegar, and many others, muſt belong to the chymiſts mercury; tho' it appear not why ſome of them ſhould rather be comprehended under one denomination, than the chymiſts ſulphur or oil; for their diſtilled oils are alſo fluid, volatile, and ſapid, as well as their mercury. Nor is it neceſſary that their ſulphur ſhould be unctuous, or diſſoluble in water; ſince they generally refer ſpirit of wine to ſulphurs; tho' that ſpirit be not unctuous, and will readily mix with water. So that bare inflammability muſt conſtitute the eſſence of the chymiſts ſulphur; as the contrary, joined with any taſt, entitles a diſtill'd liquor to be their mercury. Now, ſince ſpirit of nitre, and ſpirit of harſhorn, will boil together, hiſs, and throw up one another into the air; which the chymiſts make ſigns of great antipathies in the nature of bodies; ſince I have obtained two ſorts of oil from the ſame parcel of human blood, that would not mix with one another; and ſince I have met with ſeveral examples of the contrariety of bodies, which, according to the chymiſts, muſt be huddled up together under

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one denomination; I leave it to be consider'd, whether such a multitude of substances, as may agree in these slight qualities, and yet disagree in others more considerable, deserve to be call'd by the name of a principle; rather than to have such appellations, as may distinguish them in name, from the bodies they no way resemble in nature. And hence also, by the way, 'tis not unreasonable to distrust the chymists method of arguing; when, being unable to shew, that a liquor is, for example, purely saline, they prove, that, at least, salt, is the predominant principle therein; because the proposed substance is strongly tasted, and all taste proceeds from salt; whereas those spirits, such as that of tartar, of hartshorn, and the like, which are reckoned to be the mercuries of the bodies that afford them, have manifestly a strong and piercing taste; as has the spirit of box, even after the acid liquor that concurr'd to compose it, hath been separated from it. And, indeed, if taste belong not to the spirit, or mercurial principle of vegetables, and animals, I scarce know how it will be distinguish'd from their phlegm; since by the absence of inflammability, it must be distinguish'd from their sulphur. And here again, we have another example of the inaccuracy of the chymical doctrine; since not only the spirits of vegetables and animals, but their oils, are very strongly tasted. Nay, a skilful and inquisitive person, who made it his business, by elaborate operations, to depurate chymical oils, and reduce them to an elementary simplicity, informs me, that he never was able to make them tastless; whence I might infer, that the proof which chymists confidently give us, of a body's being saline, is so far from demonstrating the predominancy, that it does not clearly shew so much as the presence of the saline principle in it. Again; volatile salt of hartshorn, of amber, of blood, *&c.* are very strongly scented; notwithstanding that most chymists deduce odours from sulphur; and from them argue, the predominancy of that principle in the odorous body. These things being thus premis'd, we may the better observe, how dissimilar each of those bodies are, which the chymists call the salts, the sulphurs, or the mercuries of the bodies which yield them; as if they had all a natural simplicity, and indentity of nature; whereas salts, for instance, if they were all elementary, would differ as little as the drops of pure and simple water. 'Tis known, that both chymists and physicians ascribe to the fix'd salts of calcined bodies, the virtues of their concretes; and, consequently, very different operations. So we find the alkali of wormwood, much commended in distempers of the stomach; that of eye-bright, in a weak sight; and that of guaiacum, in the venereal disease. And tho' I have long thought, that these alkaline salts are, for the most part, very nearly allied to each other; and retain very little of the properties of the concretes, whence they were separated; yet I have observed at the glass-house, that sometimes the metal proves of a very different colour, and a somewhat different

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Chymiſtry. I have found ſuch various chymical diſtinctions of ſalts, that I cannot but ſay, the chymiſts give themſelves a ſtrange liberty, to call concretes by that name; which, according to their own rules, are to be look'd upon as very compounded bodies; ſo that among thoſe very ſalts which ſeem elementary, becauſe produced upon the analyſis of the bodies that yield them, there is not only a viſible diſparity, but a manifeſt contrariety; as is evident in the ebullition and hiſſing that enſue, when the acid ſpirit of vitriol, for inſtance, is poured upon pot-aſhes, or ſalt of tartar. And not only the ſame body may have two ſalts of a contrary nature, as happens in the ſpirit and alkali of nitre; but from it there may, without addition, be obtained three different, viſible ſalts. For in urine there is a volatile and cryſtalline ſalt, a fixed ſalt, and a kind of ſal-armoniac, or ſuch a ſalt as will ſublime in the form of a ſalt; and therefore is not fixed, tho' far from being ſo fugitive as the volatile ſalt, from which it ſeemed alſo otherwiſe to differ. I have, indeed, ſuſpected, that this may be a proper ſal-armoniac, compounded of the volatile ſalt of urine, and the fixed one of the ſame liquor. And for an ocular proof of the difference betwixt the fixed and volatile ſalt of wood, I deviſed the following experiment. I took a ſtrong ſolution of common *Venetian* ſublimate, made in fair water, and a clear lixivium of wood aſhes; then, on one part of the former ſolution, dropping a little of the latter, the liquors preſently turned of an orange colour; but to another part of the clear ſolution of ſublimate, putting ſome of the volatile ſalt of wood; the liquor immediately turned white, almoſt like milk; and, after a while, let fall a white ſediment, as the other did a yellow one.

In ſulphurs or chymical oils. This diſparity is, alſo, very remarkable in the ſeparated ſulphurs, or chymical oils of things. For they contain ſo much of the ſcent, taſt, and virtues of the bodies whence they were drawn, that they ſeem to be but the material frame of their concretes. Thus the oils of cinnamon, cloves, *&c.* appear to be but the united aromatic parts of thoſe bodies. And 'tis a known thing, that oil of cinnamon, and oil of cloves, with that of ſeveral woods, will ſink to the bottom of water; whilſt thoſe of nutmegs, and ſeveral other vegetables, ſwim upon it. Oil of roſes ſwims at the top of water, in the form of a white butter; which I remember not to have obſerved in any other oil, drawn in an alembic; yet there is a way by which I have ſeen it ſurprizingly brought over, in the form of other aromatic oils. In oil of aniſeeds, which I drew both with and without fermentation, I obſerved the whole body of the oil, in a cool place, to thicken into the conſiſtence and appearance of white butter; which, with the leaſt heat, reſumed its former liquidity. In the oil of olive, drawn over in a retort, I have, likewiſe, more than once ſeen, a ſpontaneous coagulation in the receiver; and thus congeal'd, it has a ſtrangely penetrating ſcent, as if it would perforate the noſe that approached it.

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The like pungent odour I alſo obſerv'd in the diſtill'd liquor of common ſope, which, forced over from *minium*, has afforded an oil moſt admirably piercing. And he muſt be a great ſtranger, both to the writings and preparations of chymiſts, who ſees not in the oils, they diſtil from vegetables and animals, a conſiderable and obvious difference. Nay, from the ſame animal or vegetable, there may often be extracted oils of natures greatly different.

I took a pound of aniſeeds, groſly bruiſed, and caus'd them to be put into a very large glaſs retort, almoſt fill'd with fair water; and placing this retort in a ſand furnace, a very gentle heat was adminiſtred, during the firſt day, and a great part of the ſecond, till the water coming over, had brought with it moſt of the volatile and aromatic oil of the ſeeds; then, increaſing the fire, and changing the receiver, I obtain'd, beſides an empyreumatical ſpirit, a quantity of aduſt oil, whereof a little floated upon the ſpirit; but the reſt was more heavy, and not eaſily ſeparable from it. And tho' theſe oils were very dark, and ſmell'd ſo ſtrongly of the fire, that their odour did not betray from what vegetable they had been forc'd; the other aromatic oil was enrich'd with the genuine ſmell and taſt of the concrete, and ſpontaneouſly coagulated into a white butter. There is another ſort of bodies, which, tho' not obtain'd by diſtillation, many chymiſts call ſulphur; being, for the moſt part, high colour'd, as diſſolv'd ſulphurs uſually are: but eſpecially becauſe they are generally abſtracted and ſeparated from the reſt of the maſs by ſpirit of wine; which liquor, thoſe men ſuppoſing to be ſulphureous, they conclude, that what it works upon and abſtracts, muſt be a ſulphur alſo. And upon this account, they preſume that they can ſeparate the ſulphur even of minerals and metals; from which, 'tis known, they cannot, by fire alone, obtain it. But if theſe ſequeſtred ſubſtances, were indeed the ſulphurs of the bodies whence they are drawn, there would as well be a great diſparity betwixt chymical ſulphurs, obtain'd by ſpirit of wine, as I have already ſhewn there is betwixt thoſe, obtain'd by diſtillation, in the form of oils; for 'tis plain, that in tinctures, drawn from vegetables, if the ſuperfluous ſpirit of wine be diſtill'd off, it leaves at the bottom the thicker ſubſtance, which chymiſts call the extract of the vegetable. And that theſe extracts are endow'd with very different qualities, according to the nature of the particular bodies that afforded them, is freely confeſs'd both by phyſicians and chymiſts.

And here too, we may take notice, that the chymiſts, in this caſe, as in many others, allow themſelves to abuſe words; for not again to argue from the different properties of tinctures, that they are not exactly pure and elementary ſulphurs; they would eaſily appear not to be ſo much as ſulphurs; altho' we ſhould allow chymical oils to deſerve that name. For, however in ſome mineral tinctures, the natural fixedneſs of the body extracted, does not always ſuffer it, to be, with eaſe, further reſoluble into different ſubſtances; yet in very many ex-

Chymiſtry. tracts, drawn from vegetables, it may very eaſily be manifeſted, that the ſpirit of wine has not ſequeſtred the ſulphureous ingredient from the ſaline and mercurial ones; but diſſolv'd the finer parts of the concrete, and united it ſelf with them into a kind of magiſtery; which therefore muſt contain ingredients, or parts of ſeveral ſorts: for we ſee, that the ſtones which are rich in vitriol, being often drench'd with rain water, yield thereto a fine tranſparent ſubſtance, coagulable into vitriol; and yet, tho' this vitriol be readily diſſoluble in water, it is not a true elementary ſalt, but a body reſoluble into very different parts, whereof one is yet of a metalline, and conſequently not of an elementary nature. We may conſider alſo, that common ſulphur is readily diſſoluble in oil of turpentine, tho' it abounds as well in ſalt as in true ſulphur; witneſs the great quantity of ſaline liquor it affords, when ſet to flame away under a glaſs bell. Nay, I have with the ſame oil of turpentine alone, eaſily diſſolv'd crude antimony, finely powder'd, into a blood red balſam, wherewith, perhaps, conſiderable things may be perform'd in ſurgery. And 'tis not unlikely, that ſpirit of wine, which, by its pungent taſt, and ſome other qualities, eſpecially its being reducible, according to *Helmont*, into alkali and water, ſeems to be as well of a ſaline, as of a ſulphureous nature, may well be ſuppos'd capable of diſſolving ſubſtances that are not meerly elementary ſulphurs, tho' perhaps they abound with parts of kin thereto. For I find that ſpirit of wine will diſſolve *Gum. Lacca*, benjamin, and the reſinous parts of jalap, and even of guaiacum; whence we may well ſuſpect, that it may from ſpices, herbs, and other leſs compact vegetables, extract not perfect ſulphurs, but mix'd bodies. And to put this paſt diſpute, there is many a vulgar extract drawn with ſpirit of wine, which committed to diſtillation, will afford ſuch different ſubſtances, as loudly proclaim it to have been a very compounded body. Hence we may juſtly ſuſpect, that even in mineral tinctures, it will not always follow, that becauſe a red ſubſtance may be drawn from a concrete, by ſpirit of wine, that ſubſtance is its true and elementary ſulphur. And tho' ſome of theſe extracts may, perhaps, be inflammable, yet beſides that others are not; and beſides that their being reduced to ſuch minuteneſs of parts, may much facilitate their taking fire; we ſee that common ſulphur, common oil, gum lac, with many unctuous and reſinous bodies, will flame, tho' they be of a very compounded nature: nay, travellers, of unſuſpected credit, aſſure us, as a known thing, that in ſome northern countries, where fir-trees and pines abound, the poorer ſort of inhabitants uſe long ſplinters, of thoſe reſinous woods, to burn, inſtead of candles. And as for the redneſs to be met with in ſuch ſolutions, I could eaſily ſhew, that 'tis not neceſſary it ſhould proceed from the ſulphur of the concrete, diſſolv'd by the ſpirit of wine; by declaring how much chymiſts delude themſelves and others, thro' ignorance of thoſe other cauſes, whereby ſpirit of wine, and other menſtrua, may

acquire

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Chymiſtry. pounded of a ſaline ingredient, and ſomewhat elſe. *Libavius*, tho' he finds great fault with the obſcurity of what the chymiſts write, concerning their mercurial principle; yet gives us ſuch a negative deſcription of it, as *Sennertus*, how favourable ſoever to the *tria prima*, is not ſatisfied with. And this *Sennertus* himſelf, tho' the learnedſt champion for the hypoſtatical principles, frequently complains of the unſatisfactorineſs of what the chymiſts teach concerning their mercury, ſubſtitutes, inſtead of the deſcription of *Libavius*, another, which many readers know not what to make of.

But ſince the mercurial principle, that ariſes from diſtillation, is unanimouſly aſſerted to be diſtinct from the ſalt and ſulphur of the ſame concrete; perhaps that may be called the mercury of a body, which, tho' it aſcend in diſtillation, as the phlegm and ſulphur, is neither inſipid, like the former, nor inflammable, like the latter; and therefore may be term'd ſpirit; which is now very much made uſe of, even by the chymiſts of our times; tho' they have not diſtinctly told us what may properly be call'd the ſpirit of a mix'd body.

However, what the vulgar chymiſts mean by the mercury of animals and vegetables, conſiſtently with their own principles, will not be ſo eaſie to find; for they aſcribe taſts only to the ſaline principle, and conſequently wou'd be much put to it, to ſhew what liquor it is, in the reſolution of bodies, that not being inſipid, is neither inflammable, as oil of ſulphur, nor has any taſt. And if we ſhou'd take ſpirit in the ſenſe of the word receiv'd among modern chymiſts and phyſicians, for any diſtill'd liquor, that is neither phlegm nor oil; the appellation wou'd yet appear ambiguous. For, plainly, that which firſt aſcends in the diſtillation of wine, and fermented liquors, is generally, as well by chymiſts as others, reputed a ſpirit: and yet, pure ſpirit of wine being wholly inflammable, ought, according to them, to be reckon'd the ſulphureous, not the mercurial principle. And among the other liquors, that paſs under the name of ſpirits, there are ſeveral which ſeem to belong to the family of ſalts; ſuch are the ſpirits of nitre, vitriol, ſea-ſalt, *&c.* And even the ſpirit of hartſhorn, being, as I have try'd, in great part, if not totally, reducible into ſalt and phlegm, may be ſuſpected to be but a volatile ſalt, diſguized by the phlegm mix'd with it, in the form of a liquor. But if this be a ſpirit, it manifeſtly differs very much from that of vinegar; the taſt of the one being acid, and the other ſalt; and the mixture of them, in caſe they be very pure, ſometimes occaſioning a ſtrong efferveſcence. And even among ſuch liquors as ſeem to have a better title than thoſe hitherto mentioned, to the name of ſpirits, there appears a ſenſible diverſity: thus ſpirit of oak, for inſtance, differs from that of tartar; and this from that of box, or guaiacum. And, in ſhort, even theſe ſpirits, as well as other diſtill'd liquors, manifeſt a great diſparity betwixt themſelves, either in their actions on our ſenſes, or in their own operations.

And

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And beſides this diſparity, to be met with among thoſe liquors, which the moderns call ſpirits, and take for ſimilar bodies; what I formerly ſaid, concerning the ſpirit of box-wood, may ſhew, that ſome of thoſe liquors, not only have qualities very different from others; but may be further reſolv'd into ſubſtances different from each other.

And ſince many modern chymiſts, and other naturaliſts, take the mercurial ſpirit of bodies for the ſame principle, under different names; I muſt obſerve, that there is a great difference, conſpicuous, betwixt all the vegetable and animal ſpirits I have mention'd, and the pureſt running mercury, ſeparated from metals; which, by ſome chymiſts, that ſeem more philoſophers than the reſt, for diſtinction ſake, call *Mercurius corporum*. Now this metalline liquor being one of thoſe three principles, of which mineral bodies are affirm'd to be compos'd, and to be reſoluble into; the many notorious differences betwixt them and the mercuries, as they call them, of vegetables and animals, will allow me to infer, either that minerals, and the two other ſorts of mix'd bodies, conſiſt not of the ſame elements; or that thoſe principles, whereinto minerals are immediately reſolv'd, which chymiſts, with great oſtentation, ſhew us, as the true principles of them, are but ſecondary principles, or mix'd bodies of a peculiar ſort, which muſt be themſelves reduced to a very different form, to be of the ſame kind with vegetable and animal liquors.

But this is not all; for tho' I formerly ſhew'd how little credit is to be given to the common chymical proceſſes of extracting the mercuries of metals; I will now add, that ſuppoſing the more judicious artiſts truly affirm, they have actually drawn true and running mercury from ſeveral metals; it may be doubted whether ſuch mercuries do not as well differ from common quick-ſilver, and from one another, as from the mercuries of vegetables and animals. *Claveus* ſpeaking of ſome experiments, whereby metalline mercuries may be fix'd into the nobler metals, * adds, that he means the mercuries drawn from metals; becauſe common quick-ſilver, by reaſon of its exceſſive coldneſs and moiſture, is unfit for that particular kind of operation, wherein, tho' a few lines before he preſcribes, in general, the mercuries of metalline bodies, yet he chiefly commends that drawn, by art, from ſilver. And he, alſo, tells us, he himſelf try'd, that, by bare coction, the quick-ſilver of tin, or pewter, may, by an efficient cauſe, be turned into pure gold †. And the experienc'd *Alexander van Suchten* ſays,

* According to M. *Homberg*, a perfect metal is nothing but very pure mercury, whoſe ſmall particles are every way pierced and filled with his ſulphureous principle, or the matter of light, which links and binds the whole maſs together. See *French Memoirs*, *A.* 1705. *p.* 122.

† Gold, according to M. *Homberg*, differs from ſilver in nothing but in having the globules of the mercury, whereof it conſiſts, penetrated through and through; and being more fully ſaturated with the ſulphureous principle, or the rays of light, which more plentifully lodge themſelves in

Chymistry. that by a way he intimates, may be made a mercury of copper, not of the silver colour of other mercuries, but green. And an eminent person lately assured me, that he had more than once seen the mercury of lead fix'd into perfect gold. And asking him, whether any other mercury wou'd not have been so chang'd by the same operations, he assured me it wou'd not.

The sulphur of antimony, which is vehemently emetic, and the strongly scented anodyne sulphur of vitriol, incline me to think, that not only mineral sulphurs differ from vegetable ones, but also from one another; retaining much of the nature of their concretes. And *Paracelsus*, in some part of his works, declares, that different bodies afford different sulphurs, salts, and mercuries.

And also in phlegm and earth.

'Tis also observable, that those bodies which chymists call phlegm and earth, are far from being of an elementary simplicity. Thus we see, the phlegm of vitriol, for instance, is a very effectual remedy against burns; and I know a very famous and experienc'd physician, whose unsuspected secret it is for discussing hard and obstinate tumors. The phlegm of vinegar, tho' drawn exceeding leisurely in a digesting furnace, I have purposely made trial of; and, sometimes, found it able to extract a saccharine sweetness out of lead; and, as I remember, by long digestion, I dissolved corals in it. The phlegm of the sugar of lead is said to have very peculiar properties: many eminent chymists teach that it will dissolve pearls, which being precipitated by the spirit of the same concrete, are thereby, they say, render'd volatile: and this has been confirm'd to me by the observation of a person of great veracity. The phlegm of wine, and indeed of several others liquors that are indiscriminately cast away as phlegm, have qualities that make them differ, both from meer water, and from each other: and tho' the chymists call the *Caput mortuum* of what they have distill'd, *terra damnata*; it may be question'd, whether or no those earths are, all of them, perfectly alike; and it is scarce to be doubted but that there are some of them which remain yet unreduced to no elementary nature. The ashes of wood, deprived of all the salt, and bone-ashes, or cancin'd hartshorn, which refiners chuse to make tests of, as freest from salt, seem unlike; and he who shall compare either of these insipid ashes to lime, and to the calx of talc, will, perhaps, see cause to think them of a different nature. And it is evident in colcothar, that the exactest calcination, follow'd by an exquisite dulcification, does not alway reduce the remaining body into elementary earth; for after the salt or vitriol is drawn out, the remainder appears to be a mix'd body, rich in medical virtues;

in its pores, than in the pores of silver; and from hence he supposes gold receives its yellow colour, and excess of gravity. And proceeding upon this supposition, he actually produced gold by introducing a large quantity of fire, or the rays of light, into silver. See *French Memoirs*, *A.* 1709. *p.* 139---143.

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Chymistry.

stances, into which the fire divides mix'd bodies, are not exactly pure and homogeneous?

Of this opinion I shall only say in general, that tho' I think it, in some respects, more defensible than that of the vular chymists; yet it may easily appear, that many of the objections, produced against the vulgar doctrine of chymists, might, without much alteration, be employ'd against this also. For this doctrine, as well as the other, takes it for granted, that the fire is the true and adequate analyzer of bodies; and that all the distinct substances, obtainable from a mix'd body by the fire, were so pre-existent in it, that they were but extricated from each other by the analysis. This hypothesis too, ascribes to the productions of the fire an elementary simplicity, which I have shewn not to belong to them; and besides, is liable to some of the other difficulties, wherewith that of the *tria prima* is incumber'd. But farther, this number of elements ought, at least, to have been restrained to the generality of animal and vegetable bodies; since not only among these, there are some, for ought has hitherto appear'd, that consist either of fewer similar substances, or more than five. But in the mineral kingdom, there is scarce one concrete, that has been shewn to be adequately divisible into five such principles, or elements, neither more nor less, as this opinion would have every mix'd body to consist of. And this very thing may serve to lessen our wonder, that just so many bodies as five, should be found upon the resolution of concretes. For since the fire cannot, as we find, make any such analysis of metals, and other mineral bodies, whose texture is more strong and permanent; it remains, that the five substances, under consideration, be obtain'd from such vegetable and animal bodies, as are capable of being distill'd. And as to such bodies, 'tis natural enough, that whether we suppose there are or are not precisely five elements; there should ordinarily occur five distinct sorts of separated parts. For if the parts do not remain all fix'd, as in gold, calcin'd talc, &c. nor all ascend, as in the sublimation of brimstone, camphire, &c. but after their dissipation, associate themselves into new arrangements of matter; it is very likely, that they will, by the fire, be divided into fix'd and volatile; with regard to that degree of heat by which they are distill'd; and those volatile parts will, for the most part, ascend either in a dry form, which chymists, if they be tastless, call flowers, and if sapid, volatile salt; or in a liquid form. And this liquor must be either inflammable, and so pass for oil, or not inflammable, and yet subtil and pungent, which may be call'd spirit; or else strengthless or insipid, and so term'd phlegm or water. And as for the fix'd part, or *Caput mortuum*, it will most commonly consist of corpuscles, partly soluble in water, or sapid, which makes up its fix'd salt; and partly insoluble and insipid, which, therefore, seem to challenge the name of earth. But tho', upon this supposition, we might easily have foretold, that the different substances, obtain'd from a perfectly mix'd body,

Whence the notion of five chymical principles?

body, by the fire, would generally be reducible to these states of matter; yet it will not presently follow, that these five distinct substances were simple and primogeneal bodies, so pre-existent in the concrete, that the fire does but take them asunder. Besides, it does not appear, that all mix'd bodies, nay, nor perhaps all vegetables, are resoluble by fire, into just such different parts of matter. Nor will the experiments formerly alledg'd, permit us to look upon these separated substances, as elementary or uncompounded. It is not a sufficient argument, of their deserving the names which chymists give them, that they have an analogy in point of consistence, volatility, fixedness, or some other obvious quality, to the supposed principles whose names they bear. For, as we said above, notwithstanding this resemblance in some one quality, there may be such a disparity in others, as should rather give them different appellations, than the resemblance entitle them to the same. And indeed, it seems but a gross way of judging of the nature of bodies, to conclude, without scruple, that those must be of the same nature, that agree in some general quality, as fluidity, dryness, volatility, and the like; since each of those qualities, or states of matter, may comprehend a great variety of bodies, otherwise of a very different nature; as we see in the calxes of gold, of vitriol, and of *Venetian* talc, compared with common ashes; which yet are very dry, and fix'd by the vehemence of the fire, as well as they. The same also appears from what I formerly observ'd as to the spirit of box-wood; which, tho' a volatile, sapid, and not inflammable liquor, as well as the spirits of hartshorn, of blood, and other things, may yet be sub-divided into two liquors, different from each other, and one of them, at least, from the generality of other chymical spirits.

Whether five be necessary in the composition of bodies?

'Tis farther urg'd, in behalf of five chymical principles, that so many appear absolutely necessary to compound mixed bodies, and to give them a due consistence, and competent duration. For salt, say the patrons of this opinion, is the basis of solidity and permanency, in compound bodies; without which the other four elements might, indeed, be variously and loosely blended together, but would remain incompact; but that salt might be dissolv'd into minute parts, and convey'd to the other substances to be compacted by it, and with it, there is a necessity of water. And that the mixture may not be too hard and brittle, a sulphureous, or oily principle, must intervene, to make the mass more tenacious: to this a mercurial spirit must be super-added; which, by its activity, may, for a while, permeate, and, as it were, leaven the whole mass; and thereby promote the more exquisite mixture, and incorporation of the ingredients. To all these a portion of earth must be join'd; which, by its dryness and porosity, may soak up part of that water, wherein the salt was dissolv'd; and eminently concur, with the other ingredients, to give the whole body the requisite consistence. This opinion I shall not now

Chymistry. now throughly examine; only observe, that such a way of arguing may be speciously accommodated to different hypotheses. For I find, that *Beguinus*, and other assertors of the *tria prima*, pretend to make ont by it, the necessity of their salt, sulphur, and mercury to constitute mixed bodies; without requiring any addition of water and earth.

And, indeed, neither sort of chymists seem to have duly consider'd, how great a variety there is in the textures and consistences of compound bodies; and how little the consistence and duration of many of them seem to agree with their notions. And, not to mention those almost incorruptible substances obtainable by fire, which I have proved to be somewhat compounded; and which the chymists will readily grant not to be perfectly mixed bodies; I have shewn by experiments, that out of common water only, mixed bodies of very different consistences, and resoluble by fire, into as many principles as other bodies, acknowledged to be perfectly mixed, may be produced. And therefore nature, by a convenient disposition of the minute parts of a portion of matter, may contrive bodies durable enough, and of any consistence, without being obliged to make use of all, much less of any determinate quantity of each of the five elements, or of the three principles, in their composition. And I have wonder'd chymists should not consider, that there is scarce any body in nature so permanent and indissoluble as glass; which yet themselves teach us may be made of bare ashes, brought to fusion by the meer violence of the fire. So that, since ashes are granted to consist but of pure salt, and simple earth, sequestred from all the other principles, or elements; they must acknowledge, that even art it self can, of two elements only, or of one principle, and one element, compound a body more durable than almost any in the world. How, then, will they prove, that nature cannot compound mixed bodies, and even durable ones, with fewer than all the five elements, or material principles?

Since, then, it may justly be doubted, whether the fire be the genuine and universal resolver of mixed bodies; since we may doubt, whether all the distinct substances, obtainable from a mixed body by the fire, were pre-existent therein, under those forms wherein they are separated from it; since, tho' we grant the substances, separable from mixed bodies by the fire, to have been their component ingredients, yet the number of such substances does not appear the same in all mixed bodies; since, lastly, those very substances thus separated, are not generally pure and elementary, but new kinds of mixed bodies; we must be allowed to say, that the vulgar experiments and arguments, alledged by chymists, to prove that their three hypostatical principles, adequately compose all mixed bodies, will not induce a wary person to acquiesce in their doctrine.

And

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry. firmneſs, the colours and figures of ſtones, minerals, and other compound bodies, the nutrition of either plants, or animals, the gravity of gold, or quick-ſilver, compared with wine, or ſpirit of wine, *&c.* from any proportion of the three ſimple ingredients, chymiſts will be much more likely to diſcredit themſelves and their hypotheſis, than to ſatisfie an intelligent enquirer.

This objection, 'tis true, may be made to the four *Peripatetic* elements alſo; and, indeed, almoſt to any other hypotheſis, that pretends, by a determinate number of material ingredients, to ſolve the phenomena of nature. But for the uſe of the *tria prima*, I know their great champion *Sennertus*, aſſigns this noble advantage thereto; that from them, as the neareſt and moſt proper principles, may be demonſtrated the properties of mixed bodies; which cannot be immediately deduced from the elements. And this, ſays he, is chiefly apparent, when we enquire into the properties and faculties of medicines.

And, indeed, if the chymiſts had been ſo modeſt, or ſo diſcreet, as to propoſe their opinion of the *tria prima*, barely as a notion uſeful, among others, to increaſe human knowledge, they had deſerved more thanks, and leſs oppoſition; but ſince the thing they pretend to is not ſo much to contribute a notion towards the improvement of philoſophy, as to make this notion paſs for a new ſyſtem, that will clear and remove all difficulties; 'tis proper they ſhould be made ſenſible of their miſtake, and be adviſ'd to take in more fruitful and comprehenſive principles, if they mean to account for the phenomena of nature.

But when I acknowledge the labours of the chymiſts uſeful to natural philoſophy, I do it upon account of their experiments, not their ſpeculations; for it ſeems to me, that their writings, like their furnaces, afford ſmoke, as well as light; and darken ſome ſubjects, as they illuſtrate others. And tho' 'tis difficult for a man to be an accompliſh'd naturaliſt, who is a ſtranger to chymiſtry; yet I look upon the common operations and practices of chymiſts, as on the letters of the alphabet, without the knowledge whereof 'tis very hard to become a philoſopher; tho' that knowledge is, by no means, ſufficient to make one.

With the advantages thereof, conſider'd.

But to conſider the doctrine of the *tria prima* a little more particularly; I ſhall readily acknowledge it has done the common-wealth of learning ſome ſervice, by helping to deſtroy that exceſſive eſteem, or veneration, wherewith the doctrine of the four elements was generally entertained; tho' what has been alledg'd concerning the uſefulneſs of theſe principles, labours under conſiderable difficulties.

And, firſt, the very way of arguing, uſed by the more learned and ſober champions of the chymical cauſe, to prove the chymical principles in mixed bodies, appears far from convincing. *Sennertus* tells us, that the moſt learned philoſophers thus prove the moſt important points in philoſophy. "Wherever," ſays he," the ſame pro-

" petties

" perties and qualities are found, they muſt neceſſarily exiſt by ſome
" common principle; thus things are heavy by reaſon of the earth;
" and hot, by reaſon of the fire they contain; but colours, odours,
" taſts, inflammability, *&c.* are found in minerals, metals, gems,
" ſtones, plants, and animals, where they conſequently reſide by ſome
" common principle: but the elements are not this principle, for they
" have no power to produce them; we muſt, therefore, enquire for
" other principles from whence they proceed."

But this argument is built upon a precarious ſuppoſition, that ſeems to me neither demonſtrable, nor true; for how does it appear, that where the ſame quality is to be met with in bodies, it muſt belong to them upon the account of ſome one body whereof they all partake? For, to begin with that very example he alledges, how can he prove, that the gravity of all bodies proceeds from participating of the element of earth; ſince we ſee, that not only common water, but the moſt pure diſtill'd rain water, is heavy; and quick-ſilver much heavier than earth it ſelf? And I the rather uſe this example of quick-ſilver, becauſe I ſee not how the aſſertors of the elements, will give any better account of it, than the chymiſts. For if we demand, how it comes to be fluid; they will anſwer, that it greatly participates of the nature of water. And, indeed, according to them, water may be the predominant element in it; ſince we ſee that ſeveral bodies, which by diſtillation afford liquors more, in weight than their *Caput mortuum*, have not, however, liquor enough to be fluid. Yet if it be demanded, how quick-ſilver comes to be ſo heavy; 'tis reply'd, by reaſon of the earth that abounds in it. But ſince, according to them, it muſt conſiſt of air, and partly of fire, which they affirm to be light elements; how comes it to be ſo much heavier than earth of the ſame bulk; tho', to fill the cavities, it be made into a maſs with water, which, it ſelf, they allow, to be a heavy element? But we ſee, that chymical oils and fixed ſalts, tho' never ſo exquiſitely purified, and freed from terreſtrial parts, remain ponderous. And experience has informed me, that a pound of the heavieſt woods, as guaiacum, that will ſink in water, will yield, when burnt to aſhes, a much leſs weight of them than lighter vegetables; as alſo, that the black charcoal of it will not ſink, as did the wood, but ſwim: which argues, that the different gravity of bodies proceeds chiefly from their particular texture; as is manifeſt in gold, the cloſeſt and moſt compact of bodies; which is many times heavier than we can poſſibly make any parcel of earth of the ſame bulk. I will not examine what may be argued from the gravity of the celeſtial bodies, from the motion of the ſpots in the ſun, and from the apparent equality of the ſuppos'd ſeas in the moon; nor conſider how little thoſe phenomena would agree with what *Sennertus* preſumes concerning it: but to invalidate his ſuppoſition, I demand, upon what chymical principle fluidity depends? And yet fluidity

Chymiſtry. is, perhaps, two or three excepted, the moſt diffuſed quality of the univerſe; and far more general than almoſt any of thoſe to be met with in the chymical principles, or *Ariſtotelian* elements; ſince not only the air, but that vaſt expanſe we call heaven; and perhaps too the ſun, and fixed ſtars, are fluid bodies. I demand alſo, from which of the chymical principles motion proceeds; which yet is a property of matter much more general than can be deduced from any of the three chymical principles? I might ask the like queſtion concerning light; which is not only to be found in the kindled ſulphur of mixed bodies, but in living glow-worms, *&c.* and in the vaſt bodies of the ſun and ſtars. I would alſo gladly know, in which of the three principles, the quality we call ſound reſides, as in its proper ſubject; ſince either oil falling upon oil, or ſpirit upon ſpirit, or ſalt upon ſalt, in a great quantity, and from a conſiderable height, will create it; and to make the objection reach the *Ariſtotelians*, water upon water, and earth upon earth. And here let us compare, a little, the ſuppoſition we are examining, with ſome other of their tenets. They teach, in effect, that more than one quality may belong to, and be deduced from one principle: for they aſcribe to ſalt taſts, and the power of coagulation; to ſulphur, odours and inflammability; and ſome of them aſcribe to mercury colours; as all of them do the property of vaniſhing in fume. On the other ſide, it is evident, that volatility belongs, in common, to all the three principles, and to water too. For 'tis manifeſt, that chymical oils are volatile; that alſo ſeveral ſalts, obtained by the analyſis of many concretes, are very volatile, is plain from their aſcending in diſtillation. How eaſily water aſcends in vapours, every body has obſerved; and as for what they call the mercurial principle, this is ſo apt to be raiſed in the form of ſteam, that *Paracelſus* and others define it by that property: hence it ſeems, that chymiſts have been very inaccurate in their doctrine of qualities, and their reſpective principles; ſince they derive ſeveral qualities from the ſame principle, and aſcribe the ſame quality to almoſt all their principles, and other bodies beſides. And hence, alſo, we may learn to judge of the plea, which that fierce champion of the *Ariſtotelians* againſt the chymiſts, *A. Guntherus Billichius* makes, where he pretends to prove, againſt *Beguinus*, that not only the four elements immediately concur to conſtitute every mix'd body, and are both preſent in it, and obtainable from it, upon its diſſolution; but that each of the *tria prima*, manifeſtly conſiſts of all the four: "for," ſays he," 'tis true, in burning green wood we ſee "water in the ſweat; air in the ſmoke; fire in the flame; and earth in "the aſhes; but if *Beguinus* will collect the aqueous moiſture, reſtrain "the oil, and extract the ſalt; I undertake to ſhew him all the four "elements in each of them, after his own method: thus, for example, "expoſe the water to the fire, and 'twill exhale in vapour; that is, "the air; whilſt fire is perceptible in the heat, and earth in the ſediment."

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Chymistry. disagree in such considerable qualities, can be both call'd portions of an element, whose nature requires it to be homogeneous: the saline part of ashes is very strongly tasted, and easily soluble in water; whilst the other part of the same is insipid, and indissoluble in that liquor: not to add, that the one substance is opake, and the other somewhat diaphanous; nor that they differ in several other particulars; so that both these substances cannot well be elementary earth. And as to what is sometimes objected, that the saline tast of ashes is only an effect of the fire; we before shew'd, that tho' insipid earth may, perhaps, by additions, be turn'd into salt; yet 'tis not likely, that it should be so by the fire alone. In refining gold and silver, the most violent fire we can employ, gives them not the least relish of saltness. And refiners, we have said, use bone-ashes for tests and cupels, which ought to be destitute of salt, lest the violence of the fire should bring them to vitrification. And indeed, having purposely tasted a cupel, made of only bone-ashes and fair water, which I had caus'd to be expos'd to a very violent fire, blown with a large pair of double bellows, I could not perceive, that the force of the fire had imparted to it the least saltness, or so much as made it less insipid.

But farther, when our author, tho' a learned man, and one who pretends skill enough in chymistry to reform the whole art, comes to give us an ocular demonstration, as he calls it, of the immediate presence of the four elements in the resolution of green wood; he is oblig'd to say things inconsistent with one another: for, he makes the sweat, as he terms it, of green wood, to be water; the smoke, air; the shining matter, fire; and the ashes, earth; tho' presently after, he will, in each of these, nay, in one distinct part of the ashes, shew the four elements. So that either the former analysis, must be insufficient to prove that number of elements; since the burnt concrete is not thereby reduced into elementary bodies, but into such as are yet each of them compounded of the four elements; or else these qualities, from which he endeavours to deduce the presence of all the elements in the fix'd salt, and each of the other separated substances, will be but a precarious proof; for the extracted alkali of wood, being, for ought appears, as similar a body as any the *Peripatetics* can shew us; if its different qualities must argue the presence of distinct elements, it will scarce be possible for them, by any way of employing the fire upon a body, to shew that any substance is the portion of a true element. This shews, that the *Peripatetics*, as well as the chymists, take some things for granted, which they ought to prove. And when *Sennertus* infers, that because the qualities he mentions, as colours, odours, and the like, belong not to the elements, they therefore must to the chymical principles; he takes that for granted, which will not easily be prov'd. Thus much may suffice, to shew the weakness of supposing that almost every quality must have some native

receptacle, wherein, as in its proper ſubject of inheſion, it peculiarly reſides; and on whoſe account that quality belongs to the other bodies, wherein it is to be met with. And this fundamental hypotheſis being deſtroyed, whatſoever is built upon it muſt fall.

I further conſider, that chymiſts are far from being able to explain, by any of the *tria prima*, thoſe qualities of matter which they pretend to belong primarily to it, and in mix'd bodies to deduce from it. 'Tis true indeed, ſuch qualities are not explicable by the four elements; but it will not therefore follow, that they are ſo by the three hermetical principles.

I allow then, that the chymiſts do juſtly accuſe the doctrine of the four elements of inſufficiency: but I am miſtaken if our hermetical philoſophers themſelves, need not, as well as the *Peripatetics*, have recourſe to more fruitful and comprehenſive principles than the *tria prima*, to make out the properties of the bodies they converſe with. Thus the vulgar chymiſts aſcribe colours, for inſtance, to mercury; *Paracelſus*, to ſalt; and *Sennertus*, to ſulphur. And *Sennertus*, I fear, wou'd have been exceedingly puzzled to ſolve, by the *tria prima*, half that catalogue of problems, which he challenges the vulgar *Peripatetics* to explain by the four elements. And ſuppoſing it true, that ſalt or ſulphur were the principle to which this or that quality may be peculiarly referr'd; yet this is not enough, in any tolerable meaſure, to ſatisfie an inquiſitive ſearcher after truth. For what is it to know, that ſuch a quality reſides in ſuch a principle or element, whilſt I remain altogether ignorant of the cauſe of that quality, and the manner of its production and operation? How little do I know, more than any ordinary man, of gravity, if I know no more than that the heavineſs of mixed bodies proceeds from that of the earth they are compos'd of; and know not why the earth is heavy? And how little does the chymiſt inſtruct the philoſopher in the nature of purgation, if he only tells him, that the purgative virtue of medicines reſides in their ſalt? Tho' to this it may be objected, that the purging parts of many vegetables, extracted by infuſion, are mix'd with oil, and ſpirit, and earth; and that quick-ſilver precipitated, either with gold or without it, into a powder, is ſtrongly cathartic, notwithſtanding the chymiſts have not proved, that either gold or mercury contain any ſalt at all, much leſs any that is purgative. But even upon their own ſuppoſition, what is it to know that the ſalt of rhubarb, for inſtance, purges, if that does not purge as ſalt; for ſcarce any elementary ſalt is, in a ſmall quantity, cathartic; and if we know not how purgation in general is effected in a human body? In a word, as 'tis one thing to know a man's lodging, and another to be acquainted with him; ſo it may be one thing to know a ſubject, wherein a quality reſides, and another to have a right notion of the quality it ſelf. Now the reaſon of this deficiency ſeems to be the ſame which renders the *Ariſtotelian*, and ſeveral other theories, inſufficient to explain

Chymistry. plain the origin of qualities. For I am apt to think, men will never be able to account for the phenomena of nature, while they endeavour to deduce them only from the presence and proportion of particular material ingredients; and consider them in a state of rest: most of the properties of matter seem to depend upon the motion, and contrivance of the small parts of bodies. 'Tis by motion, that one part of matter acts upon another; and 'tis, for the most part, the texture of the body, upon which the moving parts strike, that modifies the motion or impression, and concurs with it, to produce those effects which come under the consideration of the naturalist.

It will still be urged, that this is an useful discovery; for, since in the salt of one concrete, in the sulphur of another, and in the mercury of another, the medicinal virtue of it resides; that principle being separated from the rest, the desired faculty may be obtained. But such doctrine seems useful to apothecaries, rather than philosophers; to make things operate being sufficient to the former; whilst the cause is the thing look'd after by the latter. Besides, it will not presently follow, that because the purgative, or other virtue of the simple, may be easily extracted by water, or the spirit of wine, that it resides in the salt or sulphur of the concrete; since unless the body hath before been resolv'd by the fire, or some other powerful agent, it will, for the most part, afford in those liquors, rather the finer compound parts of it self, than such as are elementary. Thus water will not only dissolve pure salt, but crystals of tartar, gum arabic, myrrh, and other compound bodies; and spirit of wine, not only the pure sulphur of concretes, but likewise the whole substance of several resinous bodies, as *Benzoin. Gum. Lacca*, &c. And we see, that the extracts, made either with water or spirit of wine, are not of a simple and elementary nature; but masses, consisting of the looser corpuscles and finer parts of the concretes, whence they are drawn; since by distillation they may be divided into more elementary substances.

Again, when there intervenes a chymical resolution, by the fire, 'tis seldom in the more saline or sulphureous principle, that the desired faculty of the concrete resides; but that titular salt, or sulphur, is yet a mix'd body, tho' the saline or sulphureous nature be predominant in it. For if the substances, thus separated, were pure, simple, and of a perfect elementary nature, no one wou'd be endowed with more specific virtues than another; and their qualities wou'd differ as little as those of water. And, by the way, even eminent chymists have used too great diligence in purifying some of the things, they obtain by fire, from mix'd bodies. For tho' such compleatly purified ingredients of bodies might, perhaps, be more satisfactory to our understanding; yet others are often more useful to our lives: the efficacy of such chymical productions depending most upon what they retain of the bodies, whence they are separated, or gain by the new associations of the disjoined parts; whilst, if they were merely elementary,

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Chymistry. were the same; tho' brass and steel are more convenient to make clock-wheels of, than lead or wood. Lead, barely by various applications of the fire, will lose its colour, and acquire sometimes a grey, sometimes a yellowish, sometimes a red, and sometimes an amethystine one; and after having pass'd thro' these, and, perhaps, several others, again recover its own colour, and be made a bright body: and tho' so flexible a metal, it may be made as brittle as glass; and presently be brought again to be flexible and malleable as before. Nay, the same lead, which thro' a microscope appears to be one of the most opake bodies in the world, may be reduced to a fine transparent glass; whence yet it may return to an opake nature again; and all this without the addition of any extraneous body; but merely, as we said, by the manner and method of exposing it to the fire.

Upon the whole, we may very well doubt, whether there be any determinate number of elements, or whether all compound bodies consist of the same number of material principles. For it appears from the experiments brought by the common *Peripatetics*, or by the vulgar chymists, to demonstrate that all mixed bodies consist precisely of the four elements, or the three hypostatical principles, are invalid and defective; that the other common arguments, pretended to be drawn from reason, in favour of the *Aristotelian* hypothesis, are generally grounded upon such unreasonable, or precarious suppositions, that they may as well be rejected as allowed; that if what *Paracelsus* and *Helmont* positively deliver of the alkahest, be true; it must be decided, which of the two resolvers, that, or the fire, shall determine the number of the elements, before we can be certain, how many there are; and that, as the distinct substances, whereinto the alkahest divides bodies, are affirmed to be different in nature, from those into which they are reduced by fire, and to be obtained from some bodies, more in number, than from some others; so, altho' we should acquiesce in that resolution which is made by fire, we find not that all mixed bodies are thereby divided into the same number of elements and principles; and lastly, that 'tis no more necessary to the variety, which so greatly conduceth to the perfection of the universe, that all bodies should be compounded of the same number of elements; than it would be, for a language to have all its words consist of the same number of letters.

SECT. VI.

Whether there be any elements at all.

IT may, perhaps, seem extravagant to doubt, whether there be a necessity to admit any elements, or hypostatical principles at all.

But supposing them to be certain primitive, simple, or perfectly unmixedbodies, which not being made of any others, or one another, are

are the ingredients whereof all thoſe called perfectly mixed bodies, are immediately compoſed; and into which they are ultimately reſolved; I here propoſe to examine, whether there be any one ſuch body to be conſtantly met with.

The caſe being thus ſtated, I am not reduced to deny, that there are ſuch bodies as earth, and water, quick-ſilver, and ſulphur; but I look upon earth and water as component parts of the terreſtrial globe: and tho' I will not poſitively ſay, there may not, ſometimes, either a running mercury, or a cumbuſtible ſubſtance, be obtained from a mineral or a metal; yet I need not allow either of them to be an element, in my ſenſe.

In matters of philoſophy, it ſeems a ſufficient reaſon to doubt of an important propoſition, when its truth is not eſtabliſhed by any competent proof. And, therefore, if I ſhew that the grounds upon which men allow of elements, are unſatisfactory to conſiderate perſons, I ſuppoſe my ſcruples will appear rational.

The conſiderations that induce men to think there are elements, may be referr'd to two heads: firſt, that it is neceſſary, nature ſhould make uſe of them, to conſtitute the bodies reputed mix'd. And, ſecondly, that the reſolution of ſuch bodies, manifeſts nature to have compounded them of elementary ones.

That bodies are not compoſed from all the mere elements, ſhewn in the growth of vegetables, and animals.

Now the experiments above produced, concerning the growth of pompions, mint, *&c.* ſhew, that water may be tranſmuted into all the other elements; from whence we infer, that 'tis not every thing which chymiſts call ſalt, ſulphur, or mercury, that needs always be a primitive and ingenerable body; and that nature may form a plant, without having all the elements previouſly prepared, whereof to compound it. And if we allow the relation formerly mentioned of M. *de Rochas*; not only plants, but animals and minerals too, may be produced out of water. However, there is little doubt, but the plants my own experiments afforded me, would, in caſe I had reduced them to putrefaction, have produced worms, or other inſects, as the reſembling vegetables uſually do; ſo that water may, by various ſeminal principles, be ſucceſſively tranſmuted, both into plants and animals. And if we conſider, that not only men, but ſucking children, are often tormented with ſolid ſtones in the bladder or kidneys; and even beaſts too, tho' they feed but upon vegetables, which, perhaps, are but diſguized water; it will not ſeem improbable, that ſome concretes of a mineral nature may, likewiſe, be form'd of water.

And as a plant may be nouriſhed, and, conſequently, may conſiſt of common water; ſo may both plants and animals be made up of compound bodies, without having any thing merely elementary, afforded them by nature, to be compounded. This is evident in men, who, whilſt they were infants, fed only on milk; and afterwards, altogether upon fleſh, fiſh, wine, and other perfectly mix'd bodies. It may be ſeen alſo in ſheep, who, on ſome of our *Engliſh* downs, grow very fat,

Chymiſtry. by feeding upon the graſs, without ſcarce drinking at all; and yet more manifeſtly in maggots, that feed and grow up to their full ſize, within the pulp of apples, pears, or the like fruit. We find alſo, that ſuch dungs as abound with a mixed ſalt, haſten the growth of corn, and other vegetables, much more than water alone. And a man experienced in ſuch matters, aſſures me, that, ſometimes, when, to bring up roots very early, the mould they were planted in was made over-rich, the very ſubſtance of the plant has taſted of the dung. And let us conſider a graft of one kind of fruit, upon the upper bough of a tree of another kind; as for inſtance, the ſcion of a pear upon a white-thorn; for there the aſcending liquor is already alter'd, either by the root, or, in its aſcent, by the bark, or both, and becomes a new mix'd body; as may appear by the different qualities, to be met with in the ſaps of ſeveral trees; particularly the medicinal virtue of birch-water, which I have ſometimes drunk, upon *Helmont*'s great and deſerved commendation. Now the graft being faſten'd to the ſtock, muſt neceſſarily nouriſh it ſelf, and produce fruit only out of this compound juice prepared for it by the ſtock; being unable to come at any other aliment. And conſidering how much of the vegetable fed upon, may remain in an animal; 'tis eaſy to imagine, that the blood of that animal which feeds upon this, tho' a well conſtituted liquor, with all the different corpuſcles that make it up, and kept in order by one preſiding form, may be a ſtrangely compounded body; many of its parts being themſelves compounded. So little neceſſity is there, that even in the mixtures which nature her ſelf makes in animal and vegetable bodies, ſhe ſhould have pure elements at hand to compoſe them of.

As much might, perhaps, be ſaid of minerals, and even metals, if it were as eaſy for us to make experiments, in order to the production of them, as of plants and animals. But the growth or increaſe of minerals, being uſually very ſlow; and, for the moſt part, perform'd in the bowels of the earth, where we cannot ſee it; I muſt, inſtead of experiments on this occaſion, make uſe of obſervations.

And of minerals and metals. That ſtones were not all made at once, but that ſome of them are ſucceſſively generated, may be fully prov'd by ſeveral examples. There is a famous place in *France*, known by the name of *les Caves Goutieres*, where the water falling from the upper parts of the cave to the ground, preſently condenſes there into little ſtones, of ſuch figures as the falling drops chance to exhibit; ſome of which ſtones have been preſented me. And both *Linſchoten*, and another eminent author, inform us, that, in the diamond-mines in the *Eaſt-Indies*, when having dug the earth, tho' to no great depth, they find diamonds, and take them quite away; yet in a very few years, they find new ones produced in the very ſame place: whence it ſeems probable, that nature does not always require elementary bodies to produce ſtones. And as for metals, authors of good note aſſure us, they have been obſerved to grow; ſo that what was not a mineral or metal before, became one afterwards.

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Chymistry.

From all this, 'tis not very probable, that, whensoever a mineral, or a metal, is to be generated in the bowels of the earth, nature must needs have at hand, salt, sulphur, and mercury, to compound it; for not to urge, that the two last relations seem less to favour the chymists, than *Aristotle*, who wou'd have metals generated of steams; all the observations, taken together, make it seem more likely, that the mineral earths, or those metalline steams, contain some seminal rudiment, or what is equivalent thereto; by whose plastic power, the rest of the matter, tho', perhaps, terrestrial and heavy, is, in tract of time, fashion'd into particular metalline ores, almost, as we formerly observ'd, fair water was, by the seminal principle of mint, pompions, and other vegetables, contrived into bodies, answerable to their seeds. And that such alterations of terrestrial matter, are not impossible, seems evident from that notable practice of the salt-petre boilers; who unanimously observe, that if an earth, pregnant with nitre, be depriv'd by the affusion of water, of all its true and dissoluble salt; yet the same earth will, after some years, yield them salt-petre again. For which reason, some of the most eminent and skilful of them, keep it in heaps, as a perpetual mine of salt-petre: whence it may appear, that the seminal principle of nitre, latent in the earth, does, by degrees, transform the neighbouring matter into a nitrous body.

A person of great credit, and well acquainted with the ways of making vitriol, affirm'd to me, that he had observ'd a kind of mineral, which abounds in that salt, did, by being kept within doors, and not expos'd to the free air and rains, of it self, in no very long time, turn to vitriol, not only in the outward, or superficial, but even in the most central parts.

And, I have also met with a certain kind of marcasite, that lay together in great quantities under ground; which, even in my chamber, began, in a few hours, of it self, to turn into vitriol. Now, as nature, we see, makes salt-petre out of the earth, that was once almost scentless, and did not find a very fetid, and corrosive acid liquor, and a sharp alkaline salt to compound it of; tho' these are the bodies, into which the fire resolves it; so it were not necessary, that nature should make up all metals, and other minerals, of pre-existent salt, sulphur, and mercury, tho' such bodies might, by fire, be obtain'd from them. This consideration, duly weigh'd, is very considerable in our present enquiry: and hereto agree the relations of our two *German* chymists; for it is very improbable, that so languid and moderate a heat, as that within the mines, should carry up, to so great a height, salt, sulphur, and mercury; since we find, in our distillations, that it requires a considerable degree of fire, to raise to the height of one foot, not only salt, but even mercury it self, in close vessels. And if it be objected, that, it seems, by the ill scent, sometimes observ'd after lightning, that sulphureous steams may ascend very high, without any extra-

extraordinary degree of heat; I answer, that the sulphur of silver, is, by chymists, said to be a fix'd one.

But the *Aristotelians*, and vulgar chymists, I presume, know no better than I, *à priori*, of what ingredients, nature compounds metals and minerals. For their argument, to prove that those bodies consist of such principles, is drawn *à posteriori*; I mean, their chymical analysis, which is the second topic from whence they argue.

Now, tho' chymists pretend to draw salt from some minerals, running mercury from others, and from others a sulphur, yet they have not, hitherto, taught us, by their practice, to separate any one principle from all sorts of minerals, without exception; and thence, I conclude, none of them to be an ingredient of all bodies.

The same shewn, also, from the analysis of bodies.

But, supposing that either sulphur or mercury, were obtainable from all sorts of minerals; still this sulphur, or mercury, would be a compound, not an elementary, body *. And certainly, he who takes notice of the wonderful operations of quick-silver, either the common, or that drawn from mineral bodies, can scarce be so inconsiderate, as to think it of the very same nature, with that immature and fugitive substance, which chymists call the mercury of vegetable and animal substances. So that when mercury is obtain'd, by the help of the fire, from a metal, or other mineral body; if we are unwilling to suppose it not pre-existent therein, but produced by the action of the fire, we may, at least, allow this quick-silver to have been a perfect body of its own kind, which happen'd to be intimately mingled and coagulated with the other substances, whereof the metal, or mineral, consisted. This may be exemplified by native vermillion; wherein the quick-silver, and sulphur, being exquisitely blended both with one another, and that course mineral stuff that harbours them, make up a red body, different enough from both; and yet from hence, part of the quick-silver and of the sulphur, may be easily obtain'd. Thus also in some mines, nature has so curiously incorporated silver with lead, that 'tis extremely difficult, and yet possible, to separate the former from the latter. And so in native vitriol, the metalline corpuscles are, by skill and industry, separable from the saline ones; tho' they be so coagulated with them, that the whole concrete is reckon'd among salts. Now I never could see any earth or water, properly so call'd, separated from gold or silver; and therefore, to retort the argument, I conclude, that since there are

*. M. *Homberg* has shewn, that all mineral acids will dissolve quick-silver; that some of them dissolve it easier than others; that some dissolve it totally, others but in part; leaving a blackish sediment at the bottom, which nevertheless, is easily dissolved by some other acid; that by a particular operation, made to purify mercury exactly, he obtain'd from it a quantity of a light grey powder, of different properties from, but essential to it; whence he concludes, that quick-silver is not homogeneous in all its parts. *Memoir. de l'Academ. A.* 1700. *p.* 245.

some

Chymiſtry. ſome bodies, in which, for ought appears, there is neither earth nor water; neither of thoſe is an univerſal ingredient of all bodies, counted perfectly mix'd.

It may indeed be ſaid, that the reaſon why from gold, or ſilver, we can ſeparate no moiſture, is, becauſe when it is melted out of the ore, the vehement fire, requiſite to its fuſion, forc'd away all the aqueous and fugitive parts. But *Joſephus Acoſta*, relates it, upon his own obſervation, that in *America*, there is a kind of ſilver, whereof the *Indians* ſometimes find pieces, very fine and pure, like ſmall round roots; which, tho' rare in that metal, is uſual in gold: and, beſides this, ſays he, they find ſome, which they call gold in grains; which are ſmall pieces, without mixture of any other metal, and have no need of melting or refining in the fire. And a very ſkilful, and credible perſon, affirm'd to me, that being in the *Hungarian* mines, he had the good fortune to ſee a mineral, that was there dug up, wherein pieces of gold, of the length, and alſo almoſt the bigneſs, of a human finger, grew in the ore, as if they had been parts and branches of trees. And I have my ſelf ſeen, a lump of whitiſh mineral ſtone, that look'd like a kind of ſpar, wherein there grew here and there, ſeveral little lumps of fine gold, ſome of them about the bigneſs of peaſe.

But *Acoſta* tells us, he has ſeen pieces of pure native gold, that weigh'd ſeveral pounds. And I my ſelf, have ſeen a piece of ore, lately dug up, in whoſe ſtony part there grew, almoſt like trees, ſeveral parcels of a metal, which ſeem'd to be very pure, or unmix'd with any heterogeneous ſubſtances; and were ſome of them as big as my finger.

To proceed to the conſideration of the analyſis of vegetables. My trials indeed, give me no cauſe to doubt, that five different ſubſtances, may, generally, be obtain'd from them by the fire; yet, I think, it will not be eaſily demonſtrated, that theſe deſerve to be call'd elements, in the ſenſe above deliver'd.

And before I deſcend to particulars, I muſt premiſe this general conſideration, that theſe different ſubſtances called elements, or principles, differ not from each other, as plants, animals, and metals; or as creatures, immediately produced, each by its peculiar ſeed, and conſtituting a diſtinct propagable ſort of creatures in the univerſe; for theſe are only various ſchemes of matter, that differ from each other, but in conſiſtence, and ſome very few other accidents, as taſt, ſmell, inflammability, or the want of them; ſo that by a change of texture, not impoſſible to be wrought by the fire and other agents, that have the faculty to diſſociate the ſmall parts of bodies, and afterwards to connect them after a new manner, the ſame parcel of matter may acquire or loſe ſuch accidents as ſuffice to denominate it ſalt, ſulphur, or earth; whence the fire may as well produce ſome new textures, in a parcel of matter, as deſtroy the old.

If

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um, a large portion of the salt will be driven over in the form of a liquor. And to shew, that a great part of this liquor was still true sea-salt, brought by the operation of the fire into corpuscles so small, and, perhaps, so advantagiously shap'd, as to be capable of the form of a fluid body; I poured to such spirituous salts a due proportion of the spirit of urine, and thereby, having evaporated the superfluous moisture, soon obtain'd such another concrete, both as to tast, smell, and easy volatility, as common sal-armoniac. And further, to manifest that the corpuscles of the sea-salt, and the saline ones of urine, retain their several natures in this concrete, I mixed it with a convenient quantity of salt of tartar, and committing it to distillation, soon regained the spirit of urine, in a liquid form by its self; the sea-salt remaining behind with the salt of tartar. It is, therefore, very possible, that dry bodies may, by the fire, be reduced to liquors, without any separation of elements; but barely by a certain kind of dissipation and comminution of the matter, whereby its parts are brought into a new state. If it be still objected, that the phlegm of mix'd bodies must be reputed water, because so weak a tast needs but a very small proportion of salt to impart it; I reply, that for ought appears, common salt, and several other bodies, tho' distill'd whenever so dry, and in vessels ever so close, will yield, each of them, a considerable quantity of a liquor, wherein, tho' as I lately noted, saline corpuscles abound, yet there is besides, a large proportion of phlegm; as may be easily discovered by coagulating the saline corpuscles with any convenient body; as we coagulated part of the spirit of salt with spirit of urine. And I have often separated a salt from oil of vitriol it self, by boiling it with a just quantity of mercury, and then washing the newly coagulated salt from the precipitate, with fair water. Now to what can we more probably ascribe this plenty of an aqueous substance, afforded by the distillation of such bodies, than to this, that among the various operations of the fire upon the matter of a concrete, several particles of that matter are reduced to a shape and size requisite to compose such a liquor, as the chymists call phlegm, or water? 'Tis proper here to reflect upon what we formerly said, concerning the change of quick-silver into water; for the water having but a very faint tast, if at all more than many of those liquors which chymists refer to phlegm; it seems evident from such an experiment, that even a metalline body, and therefore, much rather a vegetable or animal one, may, by a simple operation of the fire, be turn'd, in great part, into water. And since the chymists are not yet able out of gold, silver, *&c.* to separate any thing like water; I may be allow'd to conclude against them, that water is not an universal and pre-existent ingredient of mix'd bodies.

But supposing the truth of what *Helmont* relates of the alkahest's effects; it may be alledg'd, that he could transmute all reputed mix'd bodies into mere insipid water. But tho' his affirmations conclude strong-

strongly against the vulgar chymists, since they prove, that the common principles, or ingredients of things, are not permanent and indestructible, because they may be further reduced into insipid phlegm, different from them all; yet, till we can be allow'd to examine this liquor, it is not unreasonable to doubt, whether it be not something else than meer water. For, I find no other reason, why *Helmont* pronounces it so, but because it is insipid. Now sapor, being a property of matter, that relates to our organs of taste; it may very possibly happen, that the small parts of a body shall be of such a size and shape, as either by their extreme minuteness, by their slenderness, or by their figure, to be unable to pierce into, and make perceptible impressions upon the nerves, or membranous parts of the tongue or palat; and yet be fit to work otherwise upon several bodies, than meer water, and, consequently, to shew it self to be of a nature far from elementary. In dyed silk, whilst many contiguous threads make up a skein, the colour is conspicuous; but if only a very few of them be view'd, the colour will appear much fainter than before; and if only a single thread, 'tis not easie to discern any colour at all; so subtile an object wanting the force to make an impression upon the optic nerve, great enough to be taken notice of. It is also observ'd, that the best sort of oil-olive is almost tastless, tho' it be vastly remote in nature, from water. The liquor, into which mercury may be transmuted, has, sometimes, but a very languid taste; yet its operations, even upon some mineral bodies, are very peculiar. Quick-silver it self, also, tho' the corpuscles it consist of are so very small, as to get into the pores of gold, is altogether tastless. And *Helmont* several times tells us, that fair water, wherein a little quantity of quick-silver has lain for some time, tho' it acquire no certain taste, or other sensible quality, has a power to destroy worms in a human body. And a great lady, eminent for her beauty in several courts, confess'd to me, that this insipid liquor was, of all innocent washes for the face, the best she ever met with.

Besides, it deserves to be remark'd, that, as we are accustomed to drink nothing but wine, beer, or other strongly tasted liquors, there may be in several of those that pass for insipid phlegm, very peculiar and distinct tasts, tho' unheeded by us. For, to omit what naturalists affirm of apes, that they have a more exquisite palat than us; among men themselves, those who drink nothing but water, may, as I have try'd in my self, discern a great difference of taste in several waters; which one unaccustomed to drink water, wou'd take to be all alike insipid. And 'tis not impossible, that the corpuscles, into which a body is dispersed by the fire, may thereby have their figures so altered, or, by associations with one another, be brought into little masses, of such a size and shape, as to be unfit to make sensible impressions on the tongue. The sharpest spirit of vinegar having dissolv'd as much coral as it can, will coagulate with it, into a

Chymiſtry. ſubſtance, which, tho' ſoluble in water, like ſalt, is incomparably leſs ſtrongly taſted than the vinegar was before. And tho' the acid ſalts carried up with quick-ſilver in the preparation of common ſublimate, are ſo ſharp, that, moiſtened with water, they will corrode metals; yet this corroſive ſublimate, being twice or thrice re-ſublim'd with a full proportion of inſipid quick-ſilver, conſtitutes *Mercurius dulcis*; ſo call'd, becauſe the ſharpneſs of the corroſive ſalts is ſo taken away, by their combination with the mercurial corpuſcles, that the whole mixture, when prepared, is judged inſipid.

Nor earth. For ſuch reaſons I cannot admit elementary water as a conſtant ingredient of mix'd bodies. And as for earth, it may well be ſuſpected, that many ſubſtances paſs, among chymiſts, under the name of it; only becauſe, like that, they are dry, heavy, and fix'd; tho' yet very far from an elementary nature. This ſeems probable from what I formerly ſaid of that the chymiſts call the *terra damnata* of things, and particularly concerning the copper to be drawn from the *Caput mortuum* of vitriol; to which we may add a remarkable experiment made by *Johannes Agricola* upon the *terra damnata* of brimſtone. This author tells us, that having prepared an oil of ſulphur, he reverberated the remaining feces, in a moderate fire, for fourteen days; and afterwards put them, well luted up, in a wind-furnace, with a ſtrong fire, for ſix hours; propoſing to calcine them to perfect whiteneſs. But coming to break the pot, he found very little feces on the top, and thoſe grey; whilſt beneath there lay a fine red regulus, which, at firſt, he knew not what to make of; being well aſſured, that not the leaſt thing beſides the feces of the ſulphur came into the pot; and that the ſulphur it ſelf had only been diſſolved in linſeed oil. This regulus he found heavy and malleable, almoſt as lead. Having caus'd a goldſmith to draw him a wire of it, he found it to be of the fineſt copper, and ſo rightly colour'd, that a Jew of *Prague* offer'd him a great price for it. And of this metal, he ſays, he had ſix ounces from one pound of feces. Hence we may well ſuſpect, that ſince the *Caput mortuum* of the ſulphur remain'd ſo long in the fire, before it was found to be any thing elſe than a *terra damnata*; there may be other reſidences of bodies, which paſs only for the terreſtrial feces of things, and are therefore thrown away as ſoon as the diſtillation or calcination is ended, which yet, if long and ſkilfully examined by the fire, would appear to be different from elementary earth. And I have taken notice of the unwarrantable forwardneſs of common chymiſts, to pronounce things uſeleſs feces, by obſerving how often they reject the *Caput mortuum* of verdigreaſe; which is ſo far from deſerving to be call'd ſo, that not only by ſtrong fires and convenient additions, it may, in ſome hours time, be reduced to copper; but with a certain flux-powder, I have, in two or three minutes, obtain'd that metal from it. And having kept *Venetian* talc, in the heat of a glaſs-furnace, I found, after all the violence of the fire it had endured, the remaining body, tho' brittle and diſcolour'd,

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Chymiſtry. ſulphur it ſelf. Beſides, fire divides new milk into five different ſubſtances; tho runnet, and acid liquors, ſeparate it but into a coagulated matter, and a thin whey; and, on the other hand, churning divides it into butter, and butter-milk; which may, either of them, yet be reduced to other ſubſtances, different from the former. And whereas ſpirit of wine will diſſociate the parts of camphire, and make them one liquor with it ſelf; *Aqua fortis* will alſo disjoin them, and put them into motion, but ſo as to keep them together, and yet alter their texture into the form of an oil. I know, alſo, an uncompounded liquor, that an extraordinary chymiſt would not allow to be ſo much as ſaline; which from coral it ſelf, not only obtains a noble tincture, without the aſſiſtance of nitre, or other ſalts; but will carry it over in diſtillation. And I make a menſtruum, that more odly aſſociates the parts of minerals very fix'd in the fire. Whence it ſeems not incredible, that there may be ſome agent, or way of operation found, whereby ſome concretes, if not all firm bodies, are reſoluble into parts ſo very minute, and ſo apt to adhere cloſely to one another, that none of them may be fix'd enough to ſtay behind in a ſtrong fire; and, conſequently are not to be look'd upon as earth. *Helmont*, alſo, affirms, that he can reduce all the terreſtrial parts of mix'd bodies into inſipid water; whence we may argue againſt the earth's being an element. And ſince a body, from which the fire hath driven its looſer parts, is ſuppoſed to be earth, for being inſipid and fix'd; if natural agents can deprive the *Caput mortuum* of a body, of either of thoſe two qualities; or give them both to a portion of matter that had them not before; the chymiſts will not eaſily ſhew, what part of a reſolv'd concrete is earth, or that earth is a primary, ſimple, and indeſtructible body. Now, there are ſome caſes, wherein the moſt ſkilful of the vulgar chymiſts themſelves, pretend to be able, by repeated cohobations, and other operations, to make the diſtilled parts of a concrete bring its own *Caput mortuum* over the helm, in the form of a liquor; in which ſtate, being both fluid and volatile, it cannot well be taken for earth. And, indeed, by a ſkilful, but not vulgar way of managing ſome concretes, there may be more effected in this kind, than one would eaſily imagine. And, on the other hand, that either earth may be generated, or, at leaſt, that bodies, which did not before appear to be totally earth, may be ſo alter'd as to paſs for it, ſeems very poſſible, if *Helmont* hath done that by art, which he mentions in ſeveral places; eſpecially where he ſays, that he knows ways whereby ſulphur once diſſolv'd, may, all of it, be fix'd into a terreſtrial powder; and the whole body of ſalt-petre turn'd into earth.

And theſe things ſeem the leſs impoſſible, from what we have deliver'd as to the growth of vegetables, nouriſhed by water alone. And *Rondeletius* tells us of a fiſh he kept in a glaſs of water, without any other food for three years; in which ſpace it conſtantly augmented; till at length it could not come out of the orifice at which it was put in;

in; and, at laſt, grew too big for the glaſs it ſelf. Now there is no juſt reaſon to doubt, that this fiſh, if diſtill'd, would have yielded the like different ſubſtances with other animals; and becauſe the mint which I produced out of water, afforded me, upon diſtillation, a large quantity of charcoal; I think I may from hence infer, that earth it ſelf may be produced out of water; or that water may be tranſmuted into earth; and, conſequently, tho' earth could be proved an ingredient actually exiſtent in the vegetable and animal bodies, whence it may be obtained by fire; it would not neceſſarily follow, that earth, as a pre-exiſtent element, concurs with other principles to make up thoſe bodies, whence it ſeems to have been ſeparated.

It will, perhaps, be retorted upon me, that there may be elementary bodies; ſince I allow gold for an ingredient, in a multitude of different mixtures; which ſtill retains its nature, notwithſtanding all that the chymiſts, by their fires and corroſive waters, can do to deſtroy it.

Gold it ſelf, deſtructible; and new qualities producible in bodies, by a bare change of texture.

But I propoſed this example, chiefly to ſhew how nature may be conceived to have made elements; not to prove that ſhe actually has made any; and *à poſſe ad eſſe*, is no juſt inference. But to anſwer the objection more directly; I muſt own, that tho' many of the more ſober chymiſts have complained of the vulgar ones, as of cheats, for pretending to deſtroy gold; yet I know a certain menſtruum of ſo piercing and powerful a quality, that if, notwithſtanding much care and ſome ſkill, I did not greatly deceive my ſelf, I have with it, really deſtroyed even refined gold; and brought it into a metalline body, of a different colour and nature; as I found by trials purpoſely made. And I have learnt from experience, that a menſtruum may be made to ſeparate and retain ſeveral parts from bodies, which even the more judicious and experienced chymiſts have pronounced irreſoluble by the fire; tho' in neither of theſe inſtances could the gold, or precious ſtones, be analyz'd into any of the *tria prima*; but only reduced to new concretes. And, indeed, there is a great diſparity betwixt the operations of the ſeveral agents, whereby the parts of a body come to be ſeparated. Thus, for inſtance, if you diſſolve the purer ſort of vitriol in common water, the fluid will ſwallow up the mineral, and ſo diſſociate its corpuſcles, that they will ſeem to make but one liquor with thoſe of the water; and yet each of theſe corpuſcles retains its nature and texture, and remains a vitriolate and compound body. But if the ſame vitriol be expoſed to a ſtrong fire, it will then be divided, not only, as before, into ſmaller parts, but into heterogeneous ſubſtances; each of the vitriolic corpuſcles that remained entire in the water, being it ſelf, upon the deſtruction of its former texture, divided into new particles of different qualities. And tho' there were ſaline, ſulphureous, or terreſtrial portions of matter; with parts ſo ſmall, ſo firmly united together, or of a figure ſo fit to make them cohere to one another, that neither the fire, nor the uſual agents employed by chymiſts, are piercing enough to divide

their

Chymiſtry. their parts, ſo as to deſtroy the texture of the ſingle corpuſcles; yet it would not neceſſarily follow, that ſuch permanent bodies muſt be elementary; ſince 'tis poſſible there may be agents found in nature, ſome of whoſe parts are of ſuch a ſize and figure, as to take better hold of theſe ſeemingly elementary corpuſcles, than they do of the reſt; and, conſequently, may carry away ſuch parts with them, and ſo diſſolve the texture of the corpuſcle, by pulling its parts aſunder. And if it be ſaid, that, at leaſt we may this way diſcover the elementary ingredients of things, by obſerving into what ſubſtances theſe corpuſcles, that were reputed pure, are divided; I anſwer, 'tis not neceſſary ſuch a diſcovery ſhould be practicable. For if the particles of the diſſolvent, take ſuch firm hold of thoſe of the diſſolv'd ſubſtance, they muſt, together, conſtitute new bodies, as well as deſtroy the old. And the ſtrict union which, according to this hypotheſis, may well be ſuppoſed betwixt the parts of the produced body, will make it as improbable they ſhould be ſever'd but by particles of matter, that, to divide them, aſſociate, and ſtick extremely cloſe to ſuch as they ſeparate from their former adherents. Beſides, it is not impoſſible, that a corpuſcle, ſuppoſed to be elementary, may have its nature changed, without ſuffering a divorce of its parts, barely by a new texture, effected by ſome powerful agent; as I formerly ſaid, the ſame portion of matter may, eaſily, by the operation of the fire, be turned into the form of a brittle and tranſparent, or an opake and malleable body.

And, indeed, if we conſider how far the bare change of texture, whether made by art or nature, can go, in producing ſuch new qualities, in the ſame parcel of matter; and how many inanimate bodies we know to be denominated, and diſtinguiſhed, not ſo much by any imaginary ſubſtantial form, as by the aggregate of theſe qualities; and that the variation of figure, ſize, motion, ſituation, or connexion of the corpuſcles, whereof any of theſe bodies is compoſed, may alter the fabrick of it; we ſhall have cauſe to ſuſpect, that there is no need that nature ſhould always have elements provided, whereof to compoſe mix'd bodies; and that it is not ſo eaſy as chymiſts and others have hitherto imagined, to diſcern, which among the many different ſubſtances, without any extraordinary ſkill, to be obtained from the ſame portion of matter, ought, excluſive of the reſt, to be eſteem'd its elementary ingredients; much leſs to determine what primogeneal and ſimple bodies conſpir'd together to compoſe it.

I formerly intimated, that beſides mint and pompions, I produced ſeveral other vegetables, of very different natures, out of water; and therefore, 'tis not abſurd to ſuppoſe, that when a ſlender vine-ſlip, is ſet in the ground, and takes root there, it may, likewiſe, receive its nutriment from the water, attracted out of the earth by its roots, or impell'd by the warmth of the ſun, or preſſure of the ambient air, into the pores of them. This ſeems the more probable, from obſerving what

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymistry. transmuted water, a few other substances; we may much increase the variety of such bodies: altho', in this second sort of productions, the vinous parts seem scarce to retain any thing of the much more fix'd bodies, wherewith they were mingled; but only to have, by their mixture with them, acquired such a disposition, that in their recess, occasion'd by the fire, they came to be alter'd, as to shape or magnitude, or both, and associated after a new manner. Thus, as I formerly said, by the addition of a *Caput mortuum* of antimony, and some other bodies, unfit for distillation, I obtain'd from crude tartar, plenty of a very volatile and crystalline salt, greatly different in smell, and other qualities, from the usual salts of tartar.

I am, however, very far from thinking, that this salt is what *Paracelsus* and *Helmont* mean, when they speak of *Sal tartari volatilis*; and ascribe such great things to it. For, my salt falls extremely short of those virtues; not seeming, in its tast, smell, or other obvious qualities, to differ very much from salt of hartshorn, and other volatile salts, drawn from the distill'd parts of animals. Nor have I yet made trials enow to be sure that it is a pure salt of tartar, without participating of the nitrous antimony. But, because it seems more likely to proceed from the tartar, than from any of the other ingredients, and because the experiment is in it self not contemptible, nor unsuitable to the present occasion, I shall set down the method I use to make it.

A volatile salt of tartar, how prepared. Take of good antimony, salt-petre, and tartar, of each an equal weight, and of quick-lime, half the same weight; let these be powder'd, and well mix'd; this done, have in readiness a retort of earth, which must be placed in a furnace, for a naked fire, with a hole at the top, at which you may cast in the mixture, and presently stop it up again: this vessel, being fitted with a large receiver, must have a fire made under it, till the bottom and sides be red hot; and then, you must throw in the mixture, by about half a spoonful at a time; and nimbly stopping the hole, the fumes will pass into the receiver, and there become a liquor, that being rectified, will appear of a pure golden colour. This spirit abounds in the salt; part of which may easily be separated, by putting the liquor into a bolt-head, with a long narrow neck; for being plac'd, a little inclining, in hot sand, there will sublime up a fine salt, which, as I said, I find to be much of kin to the volatile salts of animals; since, like them, it has a saltish, not an acid tast; hisses upon the affusion of spirit of nitre, or oil of vitriol; precipitates coral dissolv'd in spirit of vinegar; turns syrup of violets immediately green; presently changes the solution of sublimate into a milky whiteness; and has several operations, like those I have observ'd in the sort of salts whereto I resemble it; and is so volatile, that, for distinction's sake, I call it *Sal tartari fugitivus*. What virtues it may have in physic, I have not yet had the opportunity to try; but I am apt to think they will not

not be deſpicable. A friend of mine tells me, he has done great matters in the ſtone, with a preparation, not very different from ours; and a very experienced *German* chymiſt aſſured me, that in a great city of his country, one has procured a privilege, that none but he, or by his licence, ſhould ſell a ſpirit, made almoſt after the ſame way with mine; only he leaves out the quick-lime. 'Tis alſo a common cuſtom in *France*, to bury thin plates of copper in the huſks of grapes, whence the juice has been ſqueez'd in the wine-pteſs; and by this means, the more ſaline parts of thoſe huſks, gradually working upon the copper, coagulate themſelves with it, into that bluiſh-green ſubſtance we call verdigreaſe; of which I therefore take notice, becauſe having diſtill'd it in a naked fire, I found, that by the aſſociation of the ſaline with the metalline parts, the former were ſo alter'd, that the diſtill'd liquor, even without rectification, ſeem'd, by ſmell and taſt, ſtrong, almoſt like *Aqua fortis*; and very much ſurpaſs'd the pureſt, and moſt rectified ſpirit of vinegar that ever I made. And this ſpirit I aſcribe to the ſalt of the huſks, alter'd by their mixture with the copper; becauſe I found the latter, at the bottom of the retort, in form of a crocus, or reddiſh powder; and becauſe copper is of too ſluggiſh a nature to be forced over, in cloſe veſſels by no ſtronger a heat. And 'tis, to me, remarkable, in the diſtillation of good verdigreaſe, that it never yielded me any oil, tho' both tartar and vinegar will, by diſtillation, afford a moderate proportion thereof. If likewiſe, you pour ſpirit of vinegar upon calcined lead; the acid ſalt of the liquor will, by mixing with the metalline parts, tho' inſipid, acquire, in a few hours time, a more than ſaccharine ſweetneſs; and theſe ſaline parts being, by a ſtrong fire, diſtill'd from the lead, wherewith they were incorporated, will, as I formerly noted, leave the metal behind them, alter'd in ſome qualities; whilſt themſelves aſcend partly in the form of an unctuous body, partly in that of phlegm, but, for the greateſt part, in the form of a ſubtile ſpirit, of a ſtrong ſcent, very different from that of vinegar, and of a piercing taſt, remote both from the ſourneſs of the ſpirit of vinegar, and the ſweetneſs of the ſugar of lead.

In ſhort, as the difference of bodies may depend meerly upon that of the arrangement of their common matter; ſo, the ſeeds of things, the fire, and other agents, are able to alter the minute parts of body; and the ſame agents, partly by altering the ſhape and magnitude of the conſtituent corpuſcles, partly by driving away ſome of them, and partly by a new manner of connecting them, and others with them, may give the whole portion of matter a new texture of its minute parts, and thereby make it deſerve a new and diſtinct name. So that according as the ſmall parts of the matter recede from, or work upon each other, or are connected together after ſome determinate manner, a body of a particular denomination is produced, when another happens thereby to be alter'd or deſtroy'd.

Chymiſtry.

Since, then, thoſe things which chymiſts produce by the help of the fire, are but inanimate bodies; ſince ſuch fruits of their ſkill differ from one another, but in ſo few qualities, that by fire and other agents which we can employ, we may eaſily work as great alterations upon matter, as thoſe required to change one of theſe chymical productions into another; ſince the ſame portion of matter may, without being compounded with any extraneous body, or, at leaſt, any element, put on ſuch a variety of forms, and conſequently be ſucceſſively turn'd into ſo many different bodies; and laſtly, ſince the matter, cloath'd with ſo many different forms, was, originally, only water, that, in its paſſage, thro' ſo many transformations, was never reduced into any of thoſe ſubſtances, which are reputed the principles, or elements, of mix'd bodies; except by the violence of the fire, which it ſelf divides not bodies, into perfectly ſimple and elementary ſubſtances, but into new compounds; I ſee not why we muſt needs believe, that there are any primogeneal and ſimple bodies, of which, as of pre-exiſtent elements, nature is oblig'd to compound all others. And why may ſhe not produce the bodies accounted mix'd, out of one another, by variouſly altering and contriving their minute parts; without reſolving the matter into ſuch ſimple and homogeneous ſubſtances as are pretended? Neither does it ſeem abſurd to think, that, when a body is reſolv'd, by the fire, into its ſuppos'd ſimple ingredients, thoſe ſubſtances are not true and proper elements, but rather, accidental productions of the fire; which, by ſeparating a body into minute parts, does, if thoſe parts be ſhut up in cloſe veſſels, for the moſt part, neceſſarily bring them to aſſociate after another manner than before; and ſo reduce them into bodies of thoſe different conſiſtences, that the former texture, and concurrent circumſtances, render ſuch disjoin'd particles apt to conſtitute. Thus experience ſhews us, that as there are ſome concretes, whoſe parts, when ſeparated by fire, are fitted to be put into ſuch ſchemes of matter as we call oil, ſalt, and ſpirit; ſo there are others, particularly the greateſt part of minerals, whoſe corpuſcles, being of another ſize or figure, or, perhaps, contriv'd in a different manner, will not, in the fire, yield bodies of the like conſiſtences, but rather of different textures.

To ſum up the evidence on both ſides. Firſt, we have ſeen, that the different ſubſtances, into which mix'd bodies have been commonly reſolv'd, by the fire, are not of a pure, and elementary nature; but retain ſo much of the concrete that afforded them, as to appear to be yet compounded; and often to differ in one concrete, from principles of the ſame denomination in another; ſecondly, that as to the number of theſe different ſubſtances, it is not preciſely three; becauſe, in the moſt vegetable, and animal bodies, earth and phlegm, are alſo to be found among their ingredients; and that there is not any one determinate number, into which the fire, as it is uſually em-

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Chymiſtry. miſts, as to this matter, ought to be rejected. The occaſion of making the following experiments was this. An ingenious chymiſt told me, that by endeavouring to purify an eſſential oil by rectification, he found, to his diſappointment, that tho' he diſtill'd it four or five times ſucceſſively, yet it ſtill left ſome feces; tho' he concluded, that if he ſhould undergo the trouble of diſtilling the liquor a few times more, it would come over perfectly pure, without leaving any feculency behind it. But 'twas more agreeable to my hypotheſis, that the *Caput mortuum* he complained of, was not a groſs or feculent part of the oil, ſeparated from the more pure; but a new compound produced, as other concretes alſo might be, by the operation of the fire: This conjecture is favoured by ſome experiments, I made many years before, whereby two diſtill'd liquors, barely from their mutual reactions, afforded a great quantity of an earthy and very fixed ſubſtance. And it ſeem'd agreeable to the ſame conjecture, that by obſtinately repeating the experiment, the action of the fire upon the parts of the body, expoſed to it, and their mutual operations and combinations among themſelves, and probably, too, the material concurrence of igneous particles, might produce, beſides earthy feces, other bodies not unlike thoſe that paſs for the chymiſts principles. How far the event proved agreeable to his hypotheſis, will be beſt gather'd from the phenomena themſelves, of the tryals whereof I ſhall here give an account. But firſt I muſt premiſe, that by an eſſential oil, chymiſts mean ſuch a fine oleagenous liquor, as, to prevent an empyreuma and feculent parts, has been diſtill'd with plenty of water in a limbec.

Shewn from the phenomena afforded by an eſſential oil, in repeated diſtillations.

Now, we took a pound of pure eſſential oil of aniſeeds, and having put it into a glaſs-retort of a convenient ſize, we cauſed it to be diſtill'd, (in a ſand-furnace, capable of giving a ſtrong fire) thirty-ſix times, in which train of operations, the enſuing phenomena offer'd themſelves.

As pure as the eſſential, or the etherial oils of vegetables are preſum'd to be, and as confidently as chymiſts pretend they are the pure ſulphurs, or unctuous principles, of the bodies that afford them; yet, not only the firſt diſtillation left a ſubſtance black, like pitch, at the bottom of the retort; but, at every one of the following diſtillations, ſuch a ſubſtance was either ſeparated or generated.

Tho' after a diſtillation or two, it ſeemed likely, that this pitchy ſubſtance would be every time leſs and leſs; yet I not only found, that at each diſtillation ſuch a black ſubſtance was left; but that, now and then, a ſubſequent diſtillation yielded much more of it than the precedent; which change, from leſs to more, and from more to leſs, was ſeveral times obſerved. And tho' this odd pitchy ſubſtance were, towards the latter end, found in leſs quantity, than at the beginning; yet the cauſe may well be, that the oil to be diſtill'd did ſenſibly, from time to time, decreaſe in bulk, by reaſon of the receſs of that portion of the oil, which could not but be diſſipated and loſt in

ſo many cohobations; and chiefly, by the loſs of ſo much oil as was tranſmuted into pitch and other ſubſtances.

The oil appeared, in diſtillation, more fixed or unapt to riſe than one would have expected from ſo fine and light a liquor; and eſpecially towards the latter end of the diſtillations, it was often neceſſary to employ a ſcarce credible degree of fire, to elevate all that was not turned into pitch.

The liquor did not diſtil like a pure principle or homogeneous body, as quick-ſilver does; but firſt ſome fine and light oil uſually came over, after which followed a leſs volatile oil, with another ſubſtance or two, and after that, another aſcended in a diſtinct manner.

For 'tis to be noted, that beſides the fore-mentioned black earth, there were produced, by the operation of the fire, ſeveral other ſubſtances, whereof the firſt was a wateriſh liquor or phlegm; which, after the oil had been expoſed to ſome diſtillations, began to grow very troubleſome. For being ratified by the heat of the fire into large bubbles, the incongruity between them and the oil, occaſion'd a kind of conflict, wherein theſe bubbles often ſuddenly broke, with great noiſe, and ſometimes with ſuch violence, as to ſhake and endanger the retort; which once, by this conteſt, was actually broken; yet not ſo, but that the liquors and other products of the fire were ſaved, and ſeaſonably transferred into a new retort.

Beſides this phlegm and the pitch, our operation afforded us, from time to time, a large quantity of a certain ſubſtance, which, with ſome, paſſed for a volatile ſalt; becauſe it aſcended to the upper part of the veſſel, and appeared in a dry form, almoſt like ſhort needles; and becauſe, alſo, it ſeemed, that, like a ſalt, it was diſſoluble in the ſpirituous phlegm. But tho' at firſt, I inclined to this opinion; yet having made ſome few tryals to examine the truth of it, I ſtill am a little doubtful, whether this ſublim'd body deſerve the name of a true volatile ſalt; tho' poſſibly there may be much of that contain'd in it. For I found the lumps of it, notwithſtanding their ſeeming ſponginеſs, to ſink in common water, and continue at the bottom of it, without being manifeſtly diſſolv'd by that liquor, either in the cold, or by being kept a while in a moderate heat. I alſo found this ſubſtance fuſible, like bees-wax, at the flame of a ſmall taper; and if a lump of it were kindled thereat, it would burn away, partly with a yellow flame, and partly with a flame more intenſly blue than that of rectified ſpirit of wine; but it appeared apt to go out of it ſelf.

Theſe, and ſome other things, inclin'd me to look upon our anomalous ſublimate, as a ſubſtance *ſui generis*; yet ſuch an one, as I ſuſpected to be ſomewhat of kin to a *Sal volatile oleoſum*; as camphire ſeems to be. For our ſublimate riſes without a ſtrong fire, in a dry form, and is eaſily fuſible; all which I have obſerv'd in camphire, as well as in volatile ſalts: and our ſublimate will, like camphire, diſſolve in a high rectified vinous ſpirit, without at all

colour-

Chymistry, colouring the liquor. And having long since found, by trial, that camphire will, tho' slowly, dissolve in good oil of vitriol, and make the menstruum look of a reddish brown; I put some of that solvent upon our sublimate; and after having left them for some hours together, tho' in the cold, the liquor seemed to have dissolved part of the dry body; having, by its action upon it, acquir'd a brown colour, somewhat inclining to red: and part of this liquor being put into a large quantity of common water, there seemed to emerge, by degrees, a dry body; or *flores*. But tho' I think it probable, that our anomalous sublimate may be nearer of a kin to a *Sal volatile oleosum*, than to any of the chymical principles; yet I have not hitherto found the resemblance betwixt it and such a salt, to be compleat enough to make me positively refer it to any chymical product of a known denomination: and, therefore, till I am further satisfied, I shall only add, that this volatile salt, oily sublimate, or whatever name it may deserve, was very pretty to look upon; being glittering almost like some fine flowers of benzoin: and of this we had, tho' it were very light, between two and three drams.

Besides all these different substances, our oil of aniseeds afforded us, from time to time, a litle quantity of spirit; as we concluded from two or three signs: one, that it came not over with the phlegm, and yet would mingle with that liquor, but not with the distilled oil; and another, that as it was more fixed than the oil and phlegm, so it rose later than they; and not only needed a stronger degree of fire, but was usually observed to come over in white fumes; as many spirits that are somewhat fixed do. And to shew more clearly, that this substance was a spirit; tho' it could not but be very much weakned, by being diffused through so great a quantity of phlegm as came over before it; yet its corpuscles were so many and vigorous, that when put upon the powder of crude coral, they presently began to dissolve it; and the phlegmatic spirit in a trice made a great ebullition, with noise and bubbles, whether I poured it on the fix'd salt of tartar, or the urinous and volatile salt of sal-armoniac.

Our experiment, therefore, argues, that a substance, looked upon by chymists as a homogeneous body, and which passes for one of their principles, may yet be of such a nature, as barely, by the further action of the fire, to yield a very considerable proportion of a substance, exceedingly different from that which afforded it. For we obtained a *Caput mortuum*, whose qualities were quite different from those of oil of aniseeds; since it was opake, black, dry, very difficultly fusible, and fixt, in so strong a degree of fire as made the retort that contained it, and the sand about it, red hot. This substance would lie undissolved in a highly rectified vinous spirit, into which oil of aniseeds would readily have diffused it self; without the help of heat. And tho' we made the liquor actually boil, for a long time, yet most of the *Caput mortuum* continued a black substance; only

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Chymistry. notice, they would readily dissolve powdered coral, tho' crude, and in the cold; and would make a great conflict with salt of tartar, and with that of urine; yet the greatest part of the liquor, by far, seemed to be of an aqueous nature, which a chymist would call phlegm; that is, a body that will not mingle with oil, and is otherwise exceedingly different from oil, especially an essential one, whose purity makes it totally inflammable. And the quantity of the whole liquor, consisting of acid and phlegmatic parts, was far from being inconsiderable; amounting to about two ounces, and three quarters. It may also, be worth while to observe, that we may question, whether it be necessary to suppose, with the chymists, that nature has made provision of great quantities of primordial and simple bodies; and that she is solicitous to mix them all together, for the composing of a substance, capable of affording, by the analysis of fire, salt, spirit, sulphur, phlegm and earth. I will not hence universally infer, that there are no such substances to be found, in any of those bodies called perfectly mixed, antecedently to their being exposed to the fire; but this, I think, will follow from what has been delivered, that the pre-existence of such substances, must be made out by some other way, than the bare operation of the fire; and that the grand chymical supposition will not universally hold, that what similar body soever is obtained by the operation of the fire from a concrete, committed to distillation, was formerly and actually pre-existent in it.*

And, lastly, our experiment affords us a considerable argument in favour of that part of the mechanical hypothesis, which teaches inanimate bodies to differ from one another, but in the magnitude, shape, motion, texture, and, in a word, the mechanical properties of the minute parts they consist of. For in this experiment, we see that oil of aniseeds, an uniform or similar body, as to sense, and judged so by chymists, upon an analysis of the concrete that afforded it, is, by having its parts variously agitated, shook, and rubbed against one another, and in differing manners broken, associated, and ranged, transmuted into four bodies of such differing natures and qualities, as the chymists principles and elements are known to be; and this, without the help of any true seed, or plastic principle, by the bare operation of the fire; or by the bare transposition of the constituent parts, guided but by so simple, impetuous, and unruly an agent, as the fire: unless it be said, that several particles of the fire substantially associate themselves with some parts of the oil of aniseeds; and concur with them to compose the pitch-like *Caput mortuum.* Tho' it will not, perhaps, be thought likely, thar igneous atoms should, by their combina-

* 'Tis proved by M. *Homberg*, that the oil of metals will pass into the substance of vegetables; and that vegetable oils will, in like manner, enter the substance of metals; that is, the sulphur of bodies will change its state indifferently, and pass from one kind of sulphur, to another, according as circumstances determine. *Memoir. de l' Acad.* A. 1710. p. 312.

tion

tion with the particles of an inflammable oil, produce an aqueous liquor, and that in great quantity; as we lately noted of the acid phlegm of aniſeeds, amounting to two ounces, and almoſt ſix drams. *Chymiſtry.*

Upon the whole, the phenomena obſervable in our experiment, ſeem very agreeable to the mechanical hypotheſis, and very unfavourable to that of the chymiſts. For, whether the fire be ſuppoſed to have acted merely as an agent, or efficient cauſe, or to have alſo concurred as a material one; it appears, that by changes of texture, without the addition of any viſible parts, or of any ſeed; bodies very different in colour, conſiſtence, fixedneſs, and many other qualities, may be produced from a ſubſtance not only homogeneous, as to ſenſe, but pure enough to paſs for a chymical principle.

Phenomena in the repeated diſtillations of other chymical oils.

When I framed the conjecture, that from a chymical principle, ſeveral different bodies might be obtained, by the meer operation of the fire; I endeavoured to confirm it, by making experiments upon other diſtilled oils, of natures different both from the oil of aniſeeds, and from one another. And, accordingly, whilſt our proceſs with this oil was carrying on, I took care to have diſtill'd, in the ſame furnace, oil of turpentine, oil of amber, and oil of hartſhorn.

Theſe oils were committed to the ſame perſon, who managed the oil of aniſeeds; and he, accordingly, kept a kind of journal of the number of rectifications, the quantities of pitchy matter, from time to time, afforded by them, and other phenomena, or circumſtances, that occurr'd in ſo tedious a proſecution, as I thought experiments of ſuch moment deſerved. The ſubſtance of this journal is as follows.

Two of theſe three oils, that of turpentine, and amber, and, probably, the third alſo, were diſtill'd at leaſt fifty times.

Each of the three left, from time to time, in the bottom of the retorts, whence they were drawn, a conſiderable quantity of black feces, much like thoſe left by the oil of aniſeeds. I, long after, found, in a paper, ſome of this matter left by the oil of turpentine; and, tho' I am not certain, whether it were all that was afforded by the pound of oil we employed, yet it amounted to above two ounces and five drams: and the other two oils did each of them afford a conſiderable quantity of black terreſtrial matter; tho' my aſſiſtant obſerved, that the oil of hartſhorn ſooner ceaſed to leave copious feces, than the oil of turpentine, or that of amber. But if neither of the two afforded any more than did the oil of turpentine; I look upon it as a remarkable thing, that the oil of aniſeeds, which is a fine eſſential oil, diſtill'd in a veſica, or limbec, ſhould yield above twice more of earthy matter, than any of the three other oils, that were diſtill'd but in retorts.

Of the colour of the rectified oil of hartſhorn I can ſay little, having unluckily loſt the liquor it ſelf; but the oil of amber, after the one and fiftieth diſtillation, was, indeed, very clear, yet of an amber colour, far from pale: and the oil of turpentine, that is uſually after

Chymiſtry. one rectification, a clear and colourleſs liquor, after fifty diſtillations, appeared almoſt red.

But that is much more conſiderable, which I obſerved in the quantities of the different liquors, afforded by the long ſeries of our diſtillations; for at the end of the proceſs, the remaining oil of turpentine, for inſtance, did not appear to be conſiderably, if at all, ſuperiour in bulk to another liquor, that came over with it in diſtillation, and was not true oil; for it would readily enough mix with water, but keep it ſelf in a maſs diſtinct from the oil; and weighed above three ounces and three quarters.

This odd liquor I looked upon as compounded of ſpirit, and of phlegm; for tho' the latter did ſo much exceed the other in quantity, that with an expert chymiſt, the whole liquor paſſed for phlegm; yet I not only judged ſome parts of it to be ſpirit, but found them of an acid nature too; ſince, beſides what the taſt made me ſuſpect, the compound liquor would readily begin to corrode beaten coral, even in the cold; and ſome of it being poured upon good ſalt of tartar, preſently made with it a conflict and ebullition, not without a hiſſing noiſe, and a multitude of bubbles. So, likewiſe, the ſpirituous phlegm of amber, made a conflict with ſalt of tartar, and diſſolved crude coral, as other weak acid ſpirits do. This liquor of amber was not pale, as the phlegmatic ſpirit of oil of aniſeeds; and that obtained from the oil of turpentine was high-coloured, being of a browniſh red.

And among other trials made to examine, whether the ſpirits afforded by our oils, were really acid; we put two ounces of the ſpirituous phlegm of oil of aniſeeds, upon ſome minium; and, having digeſted them a while together, found the liquor turn'd ſweet, and fit to make *Saccharum Saturni*: and this liquor, after filtration, being gently abſtracted, left in the bottom of the retort, a thick, honey-like ſubſtance; from which (the diſtillation being continued with a much ſtronger heat) there came over ſome liquor; but being in too little quantity to be rectified, we could not free it from its phelgm, and, therefore, did not find it inflammable; as I gueſſed the ſpirituous part would have been after rectification; becauſe the liquor was exceeding like the *Spiritus ardens Saturni*, in its peculiar, and very penetrating taſt and ſmell.

Two vials, one containing ſome of the oil of turpentine, and the other ſome of the oil of amber, each of them diſtill'd at leaſt 50 times, having ſtood above a year and a half to defecate; I was willing to try, whether theſe liquors would ſtill yield ſuch a black ſubſtance, as before; and cauſing each of them to be again diſtill'd in a retort, they left a greater quantity of a black and ſhining ſubſtance, than could well have been expected.

It may ſeem very odd, that ſo volatile and thin a liquor, as a chymical and rectified oil, ſhould, by the bare operation of the fire, be brought

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EXPERIMENTS AND OBSERVATIONS

Upon the Producibleneſs of

CHYMICAL PRINCIPLES.

SECT. I.

Chymiſtry.

THE pompous title of hypoſtatical principles, which chymiſts have beſtowed upon the ingredients whereof they would have mix'd bodies to conſiſt, has, perhaps, procured them a veneration from vulgar heads: but what principally recommends their doctrine to diſcerning men, ſeems to be this; that as by the help of a few, original, ſimple ingredients, join'd in different proportions, all mix'd bodies may be compounded; ſo, the natures of a multitude of them, ſeem, by this means, diſcoverable, from firſt knowing the natures of a few. He, therefore, who is unſatisfied with this hypotheſis of the *tria prima*, or that which alſo takes in water and earth, can ſcarce attack it more forcibly, than by calling their grand aſſertion in queſtion, and inquiring, whether theſe pretended principles are ingenerable and incorruptible; and whether nature only compounds and diſſociates, without either producing or deſtroying them. For if the bodies they call principles be produced *de novo*, how is it demonſtrable, that nature was obliged to take thoſe made ready to her hand, in order to compound a mix'd body? And how will it appear in every analyſis made by fire, that the ſalt, for inſtance, thereby obtain'd, was not produced from the chymical operations, but pre-exiſted in the body, in minute parts; (which, by the action of the fire, were only extricated and ſeparated from the other principles or ingredients, and afterwards brought together;) ſince, in caſe the chymical ſuppoſition be etroneous,

The chymical principles not ingenerable and incorruptible.

ous, not only the ſalt thus obtain'd, may be, in part, due to a new production, or tranſmuation, but ſome of that which was really ſalt, if any ſuch thing there were antecedent to the analyſis, might be either deſtroy'd by the operation, or made to appear under another form ? *Chymiſtry.*

Salt ſeems to be the leading principle with the chymiſts : and 'tis generally granted, that ſalts are the moſt conſiderable and active parts obtain'd by chymiſtry, from mix'd bodies ; tho' the inviſible particles, that compoſe the viſible portions of a ſalt, may, perhaps, be ſuch, and ſo contriv'd, as to make other parcels of matter, which ſhall have thoſe qualities, on account whereof, the chymiſts call a body ſulphureous, or mercurial ; as may be inſtanced in the inflammability of nitre. 'Tis therefore proper to enquire, whether ſalt, indefinitely ſpeaking, may be produced *de novo*, or deſtroy'd ; and whether, at leaſt, the particular, and very different ſpecies of ſalts, may be chang'd into one another, and thereby, after a manner, be produced, in regard to the acquir'd ſpecies of ſalt ; and deſtroyed in relation to that, which the ſame portion of matter before belong'd to. *That ſalts may be produced and deſtroy'd.*

Now, I muſt here obſerve two things ; firſt, that as ſalts differ greatly in ſeveral properties, ſome being fix'd, others volatile, ſome acid, others urinous, *&c.* the two qualities, wherein they agree, and which, therefore, make up the receiv'd notion of ſalt, in general, are, that it is eaſily diſſoluble in water, and that it affects the palat, ſo as to cauſe the ſenſe of taſt. And ſecondly, whether we allow the *Epicurean* hypotheſis, or the *Carteſian*, the firſt ſaline concretions, produced by nature, muſt have been made of atoms, or of particles, that, before their conjunction, were not ſaline ; and therefore, there is no abſurdity in conceiving, that by the action of the fire, or other fit agents, ſmall portions of matter may be ſo broken into minute parts, and theſe ſo ſhap'd and connected, as, when duly aſſociated, to compoſe a body, capable of diſſolution, in water, and of affecting the organs of taſt.

That a diſpoſition to be diſſoluble in a liquor, may be acquired by mixture, and a new texture of parts, appears from hence, that tho' powder'd ſulphur will long lie in well rectified ſpirit of wine, without being at all viſibly diſſolv'd therein ; and tho' the ſame liquor will, for as long a time, ſwim upon ſalt of tartar, without making a ſolution of it ; yet if the ſalt, and ſulphur, be mix'd together, the ſame ſpirit of wine will, in leſs than an hour, diſſolve enough of them, to be highly colour'd thereby, even without the help of external heat. Why then ſhould it be impoſſible, for the fire to reduce the corpuſcles of bodies to ſuch a minuteneſs, and aſſociate them either among themſelves, or with the corpuſcles of other bodies (which, before preparation, will not diſſolve in water ;) ſo that the pores, intercepted between them, may be enter'd, and their looſe texture diſſolv'd by that fluid ? Cryſtals of well purified ſalt-petre, may be kept dry, for many months, in an ordinary chamber ; yet, if without the addition of any

body,

Chymiſtry. body, diſſoluble in water, or the moiſt air, it be, in part, reduced, as perhaps it may be almoſt in a trice, to a fix'd alkali; this ſalt will be eaſily penetrable by the vapours that float in the air, and by this moiſture ſoon be brought to relent, and at length, to diſſolve into a liquor analagous to *Oleum tartari per deliquium.*

As for the ſapor of a ſaline body, I doubt, whether the neceſſity of it be conſiſtent with another principle, and with experience. For even thoſe pure oils, called eſſential, or etherial, are highly ſapid; yet as theſe will not diſſolve in water, there appears to be no ſtrict connection betwixt being ſapid, and being ſoluble in that fluid: whence, if bodies be reduced into a multitude of parts minute, and ſharp enough; 'tis very poſſible, that ſome of them may acquire a ſhape and ſize that fits them, ſenſibly to affect the organ of taſt, tho' the bodies themſelves are rather of another nature, than of a ſaline one. Thus a ball of glaſs, while entire, will not hurt the ſkin; but pricks it, and cauſes pain, if broken into little ſharp fragments. And the like, perhaps, may happen in the organs of taſt: for ſalt-petre, tho' it have but a faint and languid taſt; yet if carefully diſtill'd, with an addition, not diſſoluble in water, and inſipid; the parts of it being, by the action of the fire, broken aſunder, rubb'd, or ground againſt one another, 'till they are reduced to edged and pointed corpuſcles, will be reſolv'd into different ſubſtances; each whereof has an extremely ſtrong and piercing taſt. Now, whence this ſhould proceed, but from ſuch a mechanical change, as we have deſcrib'd, is not eaſy to ſay: and, perhaps, alſo the watry liquor, that comes over in this analyſis, may be produced by the operation of the fire; and the phlegm being inſipid, ſo much taſt as was in the entire nitre, may be as well deſtroyed, as thoſe of the ſpirit and alkali are generated by the ſame agent. But, perhaps, there needs no other argument to ſhew, that the ſame parts of matter, according to its different ſtates, may have the qualities which chymiſts attribute to their particular principles, than our obſervation upon chymical oils, which more ſtrongly affect the taſt, than moſt ſalts themſelves. And *Helmont* aſſures us, that by *Paracelſus*'s *Sal circulatum*, ſolid bodies, among which he particularly inſtances ſtones, may be tranſmuted into actual ſalt, equal in weight to the body whereof it was made. So that, as the chymiſts ſuppoſe, there is in theſe mix'd bodies, ſulphur, mercury, and a *Terra damnata*; the ſame portions of matter that pre-exiſted in the form of thoſe ſimple ingredients, muſt, by the operation of the fire, and an anomalous menſtruum, have been turn'd into ſalt: and if the *Helmontian* experiment be allow'd good, we may ſafely conclude, whatever becomes of the chymical ſuppoſition, that ſalt may be made of matter which was not ſalt before, and conſequently, that ſalt may be produced *de novo.*

The ſalts, properly ſo call'd, that appertain to our preſent enquiry, ſeem to be chiefly the acid ones; ſuch as vinegar, ſpirit of ſalt, *&c.* the

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry. the tongue, and the other bodies they work on, after the manner of thoſe ſubſtances we call acid.

In the volatile. We have an eminent inſtance of the production of volatile ſalts in the ſalt obtainable, by diſtillation, from ſoot; for tho' the wood we burn in our chimneys, ſeems to have nothing of the taſt, or ſmell of urinous ſalts; nor the diſſolutions of the ſaline parts of ſuch wood been obſerv'd to have any affinity, in taſt or odour, with the ſalt of ſoot; yet when wood is firſt burnt in the fire, and then the ſoot afforded by it, duly diſtill'd and rectified in proper veſſels, there is obtained a ſpirit, and a white volatile ſalt, that in ſmell, and taſt, and ſeveral operations, appear to be nearly allied to thoſe of human blood, or urine, and may eaſily be miſtaken for them.

But this double operation of the fire is not always neceſſary to the productions of volatile ſalts out of vegetables; for tho' by diſtilling them in retorts, we generally obtain no dry ſalt, but a ſouriſh ſpirit, with which I have diſſolv'd coral, lead, and other hard bodies, that urinous ſpirits would not work on; and tho' being put upon urinous ſalts, they make a great hiſſing, and conflict; yet I have from muſtard-ſeed, that had been kept for a convenient time, obtained, by diſtillation, a volatile ſalt that faſtened it ſelf prettily, in figured grains, to the upper part of the receiver, and this at the very firſt diſtillation; ſo that there was no need of rectifying the diſtill'd matter to ſeparate that ſalt. And by an eaſy way we may, out of very many vegetables, firſt duly prepared, without adding any thing to them, by bare diſtillations in retorts, obtain plenty of volatile ſpirits and ſalts, which, by their fugacity, colour, ſmell, taſt, *&c.* prove ſo like the ſalt and ſpirit of urine, ſoot, *&c.* that he who knew nothing of the manner wherein they were made, wou'd readily conclude they belong'd to one or other of thoſe ſorts of bodies.

I have, alſo, ſometimes produced a volatile ſalt, which wou'd readily be pronounced urinous, from a mineral it ſelf; nor was this the only foſſil from which experience aſſures me, ſalt of this kind is obtainable.

It is not univerſally true, that ſaline ſubſtances, which appear volatile, and aſcend in the form of ſalt, are of an urinous nature, and enemies to acids. For I have had from verdigreaſe, diſtill'd *per ſe*, with a ſtrong fire, a very acid ſpirit, which being warily rectified, afforded firſt a ſour phlegm, and then a piercing ſpirit, ſharper than it; leaving behind, in the veſſel, ſome few ſpoonfuls of a dark colour'd liquor; which, being ſet aſide, and ſuffered to reſt, did, in great part, ſhoot into tranſparent cryſtals, large, thin, and almoſt like thoſe of ſilver diſſolv'd into *Aqua fortis*: they appeared prettily figured at the edges, but were ſo odly connected among themſelves, that I could not refer them to any of the known geometrical figures; and their brittleneſs made them the leſs tractable; but their ſmell, which was ſtrange-

ſtrangely piercing, and not inoffenſive, argued them to be of the ſame nature with the acid ſpirit which had come over with them. *Chymiſtry.*

But there is a more conſtant and eaſy method of producing ſuch a volatile ſalt; for, if amber be gradually and carefully diſtill'd, it will afford, beſides the phlegm, ſpirit, and oil, a dry ſubſtance; which, tho' the chymiſts call the volatile ſalt of amber, I found to be really of an acid nature, upon ſeveral of thoſe trials, by which we diſcern a body belongs to the family of acids.

The laſt ſort of ſalts to be ſhewn producible, are the alkaline, or fix'd, which ſeem oppoſite to acid ones; making a conflict with them, and performing ſeveral operations contrary to theirs. *And in the alkaline, or lixivious.*

As to the origin of theſe fix'd ſalts of calcined bodies, the chymiſts are not of one mind: the moſt univerſal opinion, before *Helmont*'s time, and even of later chymiſts, ſeems to have been, that theſe fix'd alkalies pre-exiſt in mix'd bodies; and that the fire only ſeparates, or extricates them from the parts of the compound. But *Helmont* has ingeniouſly conjectured, that theſe lixiviate ſalts do not pre-exiſt, in their alkaline form, in the bodies that afford them; but are productions of the fire, by whoſe violent action, a part of the ſalt, which, in the concrete, is naturally all volatile, lays hold of ſome parts of the ſulphur of the ſame body, and ſo, both together are melted, and fix'd into an alkali; which fixation he exemplifies, by what happens when ſalt-petre and arſenic, tho' both volatile, being expoſed to the fire, are, by its operation, flux'd, and made to fix each other. But I doubt, whether this account be clear and ſatisfactory; eſpecially if 'tis applied to all fix'd alkalies. For it may be queſtion'd, whether it has yet been prov'd, what *Helmont* teaches, that all the ſalt of mix'd bodies, before their cumbuſtion, is volatile: nor is it declared what volatile ſalt is meant; tho' it be plain, that ſome bodies, which afford a fix'd ſalt, abound in acid ſpirits, as oak, box, *&c.* and others, as hartſhorn, blood, *&c.* abound in urinous ſalts, that exerciſe hoſtility with acids. And from ſome bodies I can obtain both acid ſpirits, and ſuch as are called urinous. 'Tis not eaſy to explain, how the volatile ſalt comes to unite it ſelf ſo intimately with the oil; and, tho' this be alſo volatile, to compoſe with it a body able to endure the violence of the fire; ſince we have more than once try'd, that the volatile ſalt of urine, or of hartſhorn, and a chymical oil, as of turpentine, or the like, being put together, the ſalt will, indeed, aſſociate to it ſelf ſome particles of the oil; but will, nevertheleſs, with them ſublime, by a very gentle fire, in the form of a ſalt. And the example that *Helmont* gives of arſenic and nitre, ſeems unſatisfactory; becauſe, upon mixing equal parts of thoſe two bodies, and, in a ſtrong crucible, fulminating them together, a great part of the mixture was driven away by the fire, ſo little alter'd, that 'twas very dangerous to be too bold with the fumes; and a large part of what remained, was fix'd only in compariſon of the crude arſenic, but not comparably to ſalt of tartar, or

Chymiſtry. other true alkali: and the conſtancy of the part that was more fixed, may, probably, be aſcribed to the ſalt-petre; which we know will, without the help of arſenic, afford a great deal of fixed ſalt, if about half of it be burnt away by the help of powder'd charcoal, or ſome other convenient ingredient. It alſo weakens this inſtance of *Helmont*'s, that there are other inſtances in which we obſerve no ſuch thing happen, as his hypotheſis would make one expect. For, common ſulphur is by chymiſts ſaid to abound in an oily part, upon whoſe account it is very inflammable; ſo that they would have other inflammable bodies to hold that property, by participating of ſulphur. That this concrete, alſo, abounds in ſalt, is evident, according to their principles, by the acid menſtruum it affords, which goes under the name of *Oleum ſulphuris per campanam.* Yet theſe ingredients, combined by nature, make up a concrete, which both in cloſe veſſels, and the open fire, is almoſt totally volatile. And in that mixture of the highly dephlegmed ſpirits of wine, and of urine, that *Helmont* calls the *offa alba*; tho' the urinous ſalts manifeſtly combine with the ſpirit of wine, which, being totally inflammable, the chymiſts refer to their ſulphur; yet the coagulated part does not, by this aſſociation of ingredients, grow fixed, but proves very volatile. It might here be urg'd, in favour of the common opinion of the pre-exiſtence of alkalies in mixed bodies, firſt, that there is no need to ſuppoſe a colliquation of ſalts, with ſulphurs, oils, or any thing elſe, to produce fixed ſalts; ſince that ſuppoſition does not explain, how two volatile bodies come to compoſe one that is fixed; and ſince 'tis plain, that a body yet more fixed, may be made without any aſſociation of different principles. For, the earth, that, together with the alkali, remains in the aſhes of a burnt body, is more fixed than the alkali it ſelf; and yet derives not its fixity from any combination of elements, or principles, but from the groſſneſs, ſolidity, or weight, and unfitneſs for avolation, in the corpuſcles it conſiſts of. Secondly, ſome inſtances are alledg'd, wherein there is ſuppoſed a diminution of the quantity of the fixed alkali of the concrete, by operations that are ſaid to carry off the volatile ſalt, before the body comes to be incinerated. But, it may be anſwer'd, that, perhaps, thoſe various operations did but rarifie and volatilize part of the pre-exiſtent alkali, and ſo left the leſs of it to be recovered by calcination; as, the chymiſts tell us, fermentation rarifies the oily parts of the juice of grapes, and ſubtilizes them into vinous ſpirits, and ſo, greatly leſſens the quantity of the oil. And thus, when wood is burnt in a chimney, 'tis not in the form of an acid ſalt, which is the only one commonly obſerv'd to be driven away by diſtillation in cloſe veſſels, but in the form of an urinous ſalt, that the ſaline part of the wood is made to aſcend; as may appear by the diſtillation of ſoot. But inſtead of inſiſting on theſe arguments, we need only obſerve, that tho' by diſtillation, or any other known way of treating ſalt-petre, there is no oil to be ſeparated from it; yet above half the body of it may be eaſily and quickly

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Chymiſtry. *Jeremy*, as a very abſterſive thing, and fit to cleanſe womens ſkins, which is a known virtue of fix'd alkalies, but no more than the former obſerv'd in common ſalt-petre; I pour'd upon it ſome ſtrong vinegar, and found, as I expected, that there preſently enſued a manifeſt conflict, with noiſe and many bubbles. Hence it appears, that *Egyptian* nitre, acknowledg'd to be a native ſalt, and made only by the evaporation of the ſuperfluous water of the *Nile*, is yet of a lixiviate nature, or, at leaſt, abounds with particles that are ſo; tho' produced without precedent incineration, and the matter of it expos'd to no violence of the fire, to make it afford an alkali.

I pretend not, however, to ſay, that alkalies may not be produced in multitudes of mix'd bodies, eſpecially in many vegetables, after the way propoſed by *Helmont*. It will ſuffice, for my purpoſe, if ſome bodies, belonging to this family, or kind of ſalts, may be produced at all. And, tho' I do not aſſert, that all fix'd alkalies are productions of the fire, or made by the help of it, yet I do not remember any, except *Egyptian* nitre, but what are.

An alkali made from ſea-ſalt.

Chymiſts, generally, look upon ſpirit of nitre, and *Aqua fortis*, as containing not alkaline, but acid ſalts; which they conclude from the taſt, as well as from the great ebullition that is made, when thoſe liquors are pour'd on ſalt of tartar, fix'd nitre, pot-aſhes, or other unqueſtion'd alkalies. That ſea-ſalt, likewiſe, contains no alkali, is generally allow'd; the ſpirit of it being juſtly reckon'd among the acid ones: and when I purpoſely examin'd that concrete, by diſtillation, the remaining ſalt, tho' the fire had been violent, was very different from alkalies; yet, I, ſeveral times, made the following experiment with ſea-ſalt, that retain'd all its acid ſpirit. Upon well-dry'd, and powder'd ſea-ſalt, plac'd in a retort, we pour'd ſometimes an equal, and ſometimes a double weight of good ſpirit of nitre, or *Aqua fortis*; and leiſurely diſtilling all that would come over, we took out the dry ſalt, remaining at the bottom; which we found much chang'd, both as to colour and taſt. This ſalt, being again powder'd, and put into a crucible, placed in a convenient fire, was, by the repeated injection of well-kindled charcoal, made to flaſh ſeveral times, almoſt like melted nitre; and when it would flaſh no longer, the remaining matter, being taken out, did, in great part, appear of an alkaline nature; for it had a fiery taſt; and if ſpirit of nitre, or *Aqua fortis*, were poured thereon, it would make an ebullition: it turn'd ſyrup of violets green, and, in ſhort, exhibited various phenomena of alkaline ſalts.

Others from ſalt-petre.

There is another way of making an alkali out of nitre, thus: pour upon it an equal weight, or half the weight, of ſtrong oil of vitriol; and having diluted the mixture, with a convenient proportion of fair water, diſtil it, by degrees, till there remain a very dry ſubſtance; powder this, and mix it well, with about an eighth part of beaten charcoal; keep them in fuſion, in a ſtrong cloſe crucible, till the maſs grow very black, and a little of it being taken out, with a wire,

taſts fiery; then, take out the mixture, which will very eaſily imbibe the moiſture of the air, and you will find it, at leaſt while 'tis hot and dry, of a more fiery lixiviate taſt, than ſalt of tartar it ſelf. It will make an ebullition with acid ſpirits, and precipitate ſeveral ſolutions made with them; it will turn ſyrup of violets green, and, in ſhort, diſcover it ſelf, many ways, to be of an alkaline nature; tho' it be aſſociated with a ſulphur, that may, by various methods, be made appear to be plentifully contain'd therein. *Chymiſtry.*

It is, alſo, remarkable, how the ſame body, without the addition of any other ſalt, may, by varying the manner of the fires application to it, be made to afford either little elſe than acid ſalts, or a leſſer or greater quantity of alkali. For, if fine ſalt-petre be dexterouſly diſtill'd, with about thrice its weight of ſome proper earth, not powder'd bricks, it will, ſometimes, afford very near as much ſpirit of nitre, as the ſalt weigh'd; and tho' this, like other liquors, be not without phlegm, yet it may be doubted, whether moſt of it were not produc'd by the tranſmuting operation of the fire: however, we may ſuppoſe, that five parts of ſix, or ſix of ſeven, have been diſtill'd into dephlegm'd ſpirit.

But, if by frequent injecting into flux'd ſalt-petre, ſmall pieces of kindled charcoal, till it will flaſh no more, fix'd nitre be made; you may obtain therefrom, half its weight of an alkaline ſalt, that many would, by its taſt and operations, gueſs to be ſalt of tartar.

But, farther, to ſhew, how much the production of this alkali depends upon the operation of the fire, which, as 'tis variouſly applied, may vary the texture of the ſalt-petre; I made the following experiment. We took a pound of good ſalt-petre, groſly beaten, and having laid it in a conical heap, upon a flat tile, that the air might, on all ſides, have acceſs to it, we cauſed the upper part of it to be kindled by a little fragment of burning coal; then, with an iron rod, we dexterouſly ſtirr'd the kindled part of the nitre, that the ignition might, preſently, be communicated to as many parts of the ſalt as poſſible: and this nimble agitation of the maſs, was continued to the end of the operation; by which method, within few minutes, we obtain'd, more than once, out of 16 ounces of ſalt-petre, 10 ounces of fix'd nitre, very lixivial in taſt and operation, and of a pleaſant greeniſh blue colour, deeper than ſalt of tartar will uſually be brought to, by being, in a crucible, kept twenty times as long in a ſtrong fire.

This experiment ſhews what quantity of alkaline ſalt is, by a different operation of the fire, obtainable from crude nitre; which, in a diſtillation, ſkilfully made for the purpoſe, may be, in great part, driven over in the form of acid ſpirit and phlegm, ſo as to leave a ſurprizingly ſmall quantity of true alkali behind it. Nay, ſometimes, I could ſcarce find any at all, tho' I purpoſely try'd to ſeparate it from the tobacco-pipe clay, wherewith the ſalt had been mix'd; and

this;

Chymistry. this, after a distillation, wherein not half of the nitre had been driven into the receiver in the form of spirit.

And, to shew, that to make the fix'd salt of nitre, the actual inflammation of it in the open air, is not necessary; and that 'tis possible to make an alkali of nitre, tho' no combustible body be added to kindle the corpuscles of the salt by its sulphur; and, by the association of some part of the sulphur, with the saline parts of the nitre, to compose an alkali; I more than once, with a convenient quantity of good salt-petre, carefully mix'd about an eighth part of tobacco-pipe clay, and putting the mixture into a crucible, closely luted at the top, we kept it, by a graduated fire, in fusion for some hours; and found, that the remaining salt was turn'd into an alkali, of a fair blue colour, like the better sort of that fix'd nitre, which is made with charcoal. These two experiments seem plainly to argue, that to the making of fix'd nitre, which is confess'd to be an alkali, a proper change of texture may suffice; whether that change be attempted in open vessels, or in close ones, with, or without the addition of the sulphur of charcoal, or any other combustible body. I, also, successfully attempted to make an alkali of salt-petre, by melting moderate quantities of it, several ways, and keeping it in fusion, with some metals. And to obviate the suspicion, that some chymists might have, of the material concurrence of a large portion of the combustible sulphur, presum'd to be in the ignobler metals, to the production of the nitrous alkali; I shall add, that our experiment succeeded, when we made it, more than once, with very fine silver, whose sulphur, if it have any, is granted to be fix'd, or incombustible. And, I remember, the last trials afforded us a bluish alkali, tho' there were employ'd a fifth part of silver in proportion to the nitre; and tho' the fire was so moderate, as not to melt the metal, that was in thin plates: and of an ounce put in, there wanted but four grains; which small loss, might well be imputed to accidents.

Alkalies transmutable into other substances.

And as lixiviate salts, and alkalies, may thus be produced, by the operation of the fire; so, may they be destroy'd, or depriv'd, of their alkaline form, and turn'd into a substance of a nobler nature, by the same. We took a tolerable quantity of a good salt of tartar, that had been purified by solution and coagulation; and having put it into a clean crucible, we kept it in a strong fire, that made the crucible red hot, for a considerable time; then, at length, giving it a stronger fire, we poured it out, and again dissolv'd as much of it as we could in cold water, which being set to run thro' cap-paper, there appear'd in the filtre, a moderate quantity of matter, that would not dissolve in the water, but was turn'd into a kind of earthy substance; then re-coagulating the solution, that had pass'd thro' the filtre, into dry salt, we again expos'd it in the crucible to a strong fire; and putting it into fresh water, we perceived it would not totally dissolve, but left, in the filtre, a slime, or mud. And, in this manner, we proceeded

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry. parent and prettily ſhap'd; but the chief thing for which I mention this experiment is, that by proceeding thus, I more than once obtained, not on the very ſurface of the water, as is uſual in the concretions of ſea-ſalt, but in other parts, and chiefly beneath the ſurface of the ſaline cruſt, a conſiderable number of grains of ſalt, that better anſwered to the deſcription of common ſalt than diſſolv'd and filter'd ſea-ſalt it ſelf; for theſe grains were large, and as like little cubes, as if they had been made by a ſkilful jeweller; and their ſurfaces had a ſmoothneſs and gloſs much ſurpaſſing what I had ever obſerved in common ſalt.

I may confirm the difference I have mentioned, to be between ſandiver and common alkalies, by this, that having ſet a large quantity of the filter'd ſolution of ſandiver to coagulate in a cool place, and thereby brought a great part of the ſalt to coagulate into cryſtals, almoſt like thoſe of nitre, but ſo very diaphanous, that ſeveral of them were clear as rock-cryſtal; I did not obſerve them to relent by the moiſture of the air, in a long time, tho' the glaſs they were kept in, was negligently covered with paper only: which argues their texture to have been remote from that which is proper to alkalies; and ſhews them to be, alſo, ſalts of a peculiar nature. If they were expoſed to a gentle heat, they would, in no long time, loſe their tranſparency, and be reduced to a fine white calx, which being weighed, and again diſſolv'd in water, and made again to cryſtallize, would be tranſparent, and coagulate with it ſelf ſo much of the water as gave a very notable increaſe of weight.

Sandiver is by ſome reckoned an artificial body; my ſecond inſtance, therefore, ſhall be in a body that ſeems natural. If human urine, after having been kept for ſome weeks in a cloſed veſſel, be expoſed to a moderate fire, it will firſt yield a ſpirit and a volatile ſalt, then a large quantity of phlegm, which being totally exhaled, there will remain a dry *Caput mortuum*; and this being warily calcined, diſſolv'd in water, and coagulated, if the experiment ſucceed, you will find the ſalt very different from a common lixiviate alkali; or rather, the ſaline concretions will differ in form, if not in kind; for I obſerved ſome to be oblong, and to look like ſmall cryſtals of nitre, but others rhomboidal: and one of the faireſt of the latter, I kept, for many days, expoſed to the air; and that in winter, without finding it run *per deliquium*; as a piece of common alkali of that bigneſs wou'd have done, in a ſmall part of the ſame time. But beſides thoſe numerous ſaline concretions that I cou'd not eaſily reduce to any known figure, there was a conſiderable number of fine grains, reſembling common ſalt; and were, indeed, more exactly cubical in their figure, than the grains of ſea-ſalt. And I have the leſs cauſe to doubt, that the ſea-ſalt, abounding in our *Caput mortuum*, was not a common lixiviate alkali, becauſe the *Caput mortuum*, when expoſed to calcination, began early to melt in the fire, before it was near calcined, not like an alkali, but ſea-ſalt; becauſe the taſt

was

was much nearer to that of brine, than to that of lixivium; and, laſtly, becauſe it would make no conflict with the ſpirit of ſalt, as an alkali would have done; but with a ſolution of ſilver in *Aqua fortis*, gave a white precipitate. Having diſſolved, and filter'd a large quantity of this ſalt of urine, and ſuffer'd the ſolution to evaporate ſlowly, till it began to have a ſkin; I found the cryſtals it afforded, in a cool place, to be, ſome of them an inch or two long, and ſhaped almoſt like cryſtals of nitre, only they were ſharper at both ends; and to many of them were faſten'd abundance of minute and oblong cryſtals, prettily ſhaped, and placed almoſt perpendicularly upon the greater portions of ſalt. Theſe cryſtals, as they did not reſemble common alkalies in figure, ſo they were unlike to them in other reſpects; for tho' oil of tartar *per deliquium*, being poured upon ſome of them, there enſued no manifeſt commotion, as happens when that liquor is mix'd with a ſalt, where an acid is predominant; yet being beaten, and mix'd with an acid ſpirit, as that of common ſalt, they made not the leaſt ebullition, or conflict, tho' they were ſtirr'd up and down to excite it. Nor did *Aqua fortis* produce any hiſſing noiſe, or froth, when it was put upon the ſalt of urine; tho' at length it diſſolved a large proportion of it. And tho' ſtrong oil of vitriol being put upon ſome of the forementioned cryſtals, did readily work upon them, and in corroding them, excited numerous bubbles; yet this did not make me conclude the ſalt to be alkaline; becauſe I have obſerved oil of vitriol, tho' not ſpirit of ſalt, or *Aqua fortis*, to work, after the like manner, upon common ſalt, whereof that the fixed ſalt of urine partook, ſeems probable from the phenomenon juſt mention'd; becauſe by impregnating good *Aqua fortis*, with a competent quantity of this fixed ſalt, inſtead of ſea-ſalt, I could make it corrode foliated gold, even without heat; becauſe ſome part of the ſolution of our fixed ſalt, that was more ſlowly coagulable, being mix'd with oil of tartar, preſently grew thick and muddy, and ſoon after let fall a large precipitate; and, laſtly, becauſe another part of the ſame ſolution did readily precipitate ſilver diſſolv'd in *Aqua fortis*, but would not diſcolour a ſtrong ſolution of ſublimate made in fair water; from which a common lixiviate alkali would have immediately ſtruck down an orange-colour'd powder.

(o) A ſuſpicion I once had, that the common ſalt, uſed to ſeaſon our aliment, might, in ſome degree, impregnate our urine, occaſioned me to examine that of horſes; which I found to require rather a ſhorter putrefaction than human urine, to fit it for diſtillation. By the ſpirit and volatile ſalt of this fluid, which are eaſily obtain'd, it ſeem'd probable, that the fixed ſalt would have been not unlike that of human urine; tho' I had not an opportunity to examine the *Caput mortuum*. I here choſe to inſtance in urine, becauſe chymiſts never extract the fixed ſalt thereof; tho' all the parts of that fluid ſeem applicable to very good purpoſes.

SECT. II.

Chymiſtry.

Different kinds of ſpirits, producible.

THE chymiſts apply the name ſpirit to ſo many different ſubſtances, that ſuch an ambiguous uſe of the word ſeems to ſhew, they have no clear and ſettled notion of the thing. Moſt of them, indeed, in the general, give the term ſpirit to any diſtill'd volatile liquor, that is not inſipid, as phlegm, or inflammable as oil. But under this general idea, they comprehend liquors that are not only of a different, but, according to their principles, of a quite contrary nature; ſome of them being acid, as ſpirit of nitre, of ſalt, and of vinegar; and others urinous, or volatile alkalies; which are ſuch enemies to the former, that as ſoon as they are put together in due proportion, they tumultuate and grow hot; and uſually continue thus, till they have diſarmed or mortified each other. Beſides the two hoſtile families of ſpirits, there is a third, called by them vinous, or inflammable; which, tho' very ſubtile and piercing, is not manifeſtly either acid or alkaline; for the taſt and ſmell of this ſpecies, is different from both the other ſorts; and yet it is referr'd to one or the other of them, by ſome learned chymiſts; with whom I need not diſpute about this matter, ſince 'tis ſufficient for my deſign, if it can be made out, that all the three ſorts of ſpirits, the vinous or inflammable, the urinous or alkaline, and the acid, may be produced.

The vinous.

And to begin with the vinous ſpirits. Theſe are ſo producible by art, that we ſeldom find them produced by nature alone, which, indeed, makes the juice of grapes, but not wine, nor the ſpirit of it; unleſs, by the help of man, that juice be preſs'd out and fermented. And the caſe is yet more plain in the inflammable ſpirits of ale, beer, and in the like, made by boiling and fermenting the ſeeds, and other parts of vegetables. And 'tis obſervable, that muſt does not, in diſtillation, yield a vinous and inflammable ſpirit. I had once the pleaſure to laugh at a man, otherwiſe very ingenious, who, to catch the ſubtile vinous ſpirit, that he would have me think was loſt in the common way of treating wort, cauſed it to work in a copper limbec; by which means he obtained nothing but a nauſeous phlegm. I have, alſo, found by trial, that raiſins diſtill'd alone, afford an acid and empyreumatical, but not a vinous ſpirit; tho' when I carefully fermented them in a due proportion of water, they would yield, in diſtillation, an inflammable ſpirit, like that of wine.

If it be objected, that the vinous and inflammable ſpirit, obtained from bodies by fermentation, was actually in them before, and is only extricated by fermentation; I anſwer, that this is *gratis dictum*, and not to be admitted without proof; ſince raiſins, and ſuch other fermentable bodies, do not, upon the ſuppoſed analyſis, made by diſtillation, afford a vinous ſpirit, but one very different from it. And I ſee not why the change

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Chymiſtry. diſcerned by the eye, tho' it afterwards becomes viſible. The preſence of this oil in moſt ſpirits belonging to this family, may, probably, be argued from the deep tincture, that, in tract of time, the ſpirits of hartſhorn, of blood, *&c.* acquire by ſtanding; tho' preſently after their diſtillation, and firſt or ſecond rectification, they were clear and colourleſs as water. But in ſpirit, drawn, by the help of an alkali, from ſal-armoniac, a concrete not abounding in oily parts, like hartſhorn, blood, *&c.* and kept for ſeveral years, I obſerved no ſuch diſcolouration. Having, therefore, hitherto, by rectifications and digeſtions, found nothing in theſe urinous ſpirits but a cryſtalline, volatile ſalt, moſt commonly ſeparable in a dry form, and the phlegm it was diſſolved in, beſides ſome oleaginous particles that had aſſociated themſelves to it; 'twere unneceſſary to alledge particular inſtances as to this ſort of ſpirituous liquors: 'tis ſufficient to refer them to our conſiderations on the production of volatile ſalts.

And the acid. That ſome acid ſpirits may be generated, or produced, *de novo*, muſt ſeem probable from what has been already deliver'd as to the production of acid ſalts; and from what we ſhall ſay of acid, urinous and volatile ſpirits, obtained by diſtillation from the ſame body. And if we take the word acid, as I here uſually do, in a familiar ſenſe, without nicely diſtinguiſhing it from thoſe ſapors that are of kin thereto; perhaps the ſpirit of ſea-ſalt, and that of nitre, may be proper inſtances of the production of acid ſpirits. For tho' ſea-ſalt, and its diſtilled liquor, have, upon ſome bodies, the like operations, as either of them will precipitate ſilver out of *Aqua fortis*, yet the taſt of the ſpirit of ſalt is exceedingly different from that of crude ſalt, not only in ſtrength and penetrancy, but in being highly acid; whereas the crude ſalt has a taſt not properly acid, but that which by a diſtinct name is called ſaline, ſuch as predominates in brine: and it does not appear that this acid ſpirit pre-exiſted in that ſtate, in the ſalt whence it was obtained; ſo that we may ſuppoſe it to have been made rather by tranſmutation than extrication. And the like, I think, may, with greater probability, be ſaid of the ſpirit of nitre; for tho' this be highly acid, yet the nitre that afforded it, is not at all ſenſibly acid: and this new vehement taſt of the ſpirituous parts, as well as their great efficacy in diſſolving metals, and other bodies, ſeems to have been produced by the violent action of the fire, which, by ſplitting the nitrous corpuſcles, or by rubbing them one againſt another, *&c.* makes a comminution of them into fragments, or particles; which, both, becauſe of their ſmallneſs and lightneſs, may be elevated by the action of the fire; and becauſe of the ſame minuteneſs, and their ſharp pointed figures, may get into the pores of many other bodies, and divide their parts. Chymiſts, indeed, may object, that all the acid ſpirit, which can be diſtill'd from nitre, was really pre-exiſtent, and only clogg'd and diſguiz'd by the alkaline ingredient, wherewith it was aſſociated; as may appear, by what I related, of the quick way of making ſalt-petre, by

putting

putting a due proportion of the spirit of nitre to the alkali, or fix'd part that remains after the salt-petre has been fulminated. This proves, indeed, what I readily grant, that salt-petre may be artificially compounded of a nitrous spirit, and a fix'd alkali; but does not prove, that nature always, or ordinarily, produces nitre, by compounding it of the same ingredients; for, it does not appear, that wherever salt-petre is generated in the earth, nature has, before-hand, laid in a provision of lixiviate salt, that is not, with us to be made, without the violence of an incinerating fire, and of corrosive spirits; to obtain which, or either of them, vehement fires are employ'd; whilst salt-petre seems to be slowly generated in the earth, by gradual, or successive alterations of some proper matter; wherein, for ought I have observ'd, not an acid, but an urinous salt is predominant; since earth, that had long lain cover'd with pigeons dung, in a dove-house, yielded a volatile spirit and salt like those of urine, in distillation. I will not, therefore, affirm, that nature never employs fix'd alkalies, and acid spirits, to make salt-petre; yet, I see not that chymists have hitherto offer'd any cogent proof, that she must necessarily do so. I farther observe, that, according to what was formerly noted, salt-petre, distill'd in close vessels, affords but an inconsiderable quantity of fix'd salt; and that too, a very imperfect alkali; tho' the quantity of nitrous spirits was great enough to persuade us, that nothing near so much as was wanting of the entire weight of the salt-petre, had pass'd into the receiver. And a friend of mine, by the help of a peculiar clay, obtain'd near a pound of spirit of nitre, from a pound of salt-petre; whilst, on the other side, by a different management, tho' without addition, I obtain'd about ten ounces of fix'd nitre from a pound of salt-petre: whence, it seems probable, that the same substance, which, in crude nitre, is almost insipid, may, by an operation of the fire, be distill'd into an highly acid spirit, as well as, by another operation and way of management, be brought to the nature of a fix'd and caustic alkali. It may, also, be worth considering, whether the perfect spirit of nitre may not be depriv'd of its acid nature, and become, or, at least, materially concur, to make up a fix'd alkali. For, if sea-salt, which chymists do not pretend contains any such alkali, be throughly dissolv'd in a sufficient quantity of spirit of nitre, the salt, thus compounded, will yield a considerable proportion of fix'd alkali, resembling that of salt-petre; which is as likely to proceed from the nitrous, as from the marine part of the resulting salt: and if so, 'tis the more probable, that the saline corpuscles of spirit of nitre, are not primordial bodies, since they may be destroy'd, or turn'd into other salts: which is not less repugnant to the nature of a principle, than 'tis to be, *de novo*, producible from a body that was not acid before.

It may add much probability, to what was above said, concerning the producibleness of the different sorts of spirits, if it shall appear, that

Chymiſtry.

The ſame body may, by being differently treated, afford five kinds of ſpirits.

that the ſame body, merely by different ways of ordering it, may be eaſily brought to afford either acid, inflammable, or volatile ſpirits, as the attiſt pleaſes.

An inſtance of this, we may have from ſome kinds of pulſe, as beans, *&c.* which, if newly gather'd, and diſtill'd in a retort, afford, beſides a great deal of phlegm, an acid ſpirit. And I had ſuch a ſpirit from either peaſe, or beans, or both, after they had been kept till they loſt their verdure. But if theſe ſeeds be, at a fit time duly fermented with common water, it will not be doubted, but that they, as well as other mealy ſeeds, muſt yield an ardent ſpirit: but, it will not be eaſily believ'd, that without adding any thing to them, and barely by keeping them in a dry place, for a certain number of months, they will yield a ſpirit, that by one, who did not know whence it proceeded, would be judg'd near a-kin to that of urine, or of hartſhorn, and to other ſaline liquors, drawn from animal ſubſtances; yet, having diſtill'd theſe pulſe, by themſelves, and without ſo much as bruiſing them, they afforded ſpirits, not only far more like in ſcent to thoſe I juſt enumerated, than they were either to acid or vinous ſpirits, but allied to them in more intimate qualities; ſince they would, as the ſpirit of urine and hartſhorn, make a conflict with acid ſpirits, turn ſyrup of violets green, diſſolve copper blue, precipitate a ſolution of ſublimate into a white ſubſtance, and give the other diſtinguiſhing marks of volatile and urinous ſalts and ſpirits.

Vegetables, alſo, may eaſily, by a dextrous ſublimation, be brought to exhibit many of their nobler parts in the form of a dry ſalt, as well as in that of a ſpirituous liquor.

The freſh juice of grapes, or muſt, tho' ſweet in taſt, will, if it be timely diſtill'd to the conſiſtence almoſt of a ſyrup, yield a great quantity of phlegm, but no ardent ſpirit; and if the ſuperfluous moiſture be ſkilfully evaporated, there will remain a kind of ſapa, of a pleaſant tartneſs, which I have known uſed in ſome places, as an excellent ingredient in ſauces, and alſo to ſpread upon bread, inſtead of butter.

An acid and a vinous ſpirit from the juice of grapes.

But if this ſapa were preſently diſtill'd, I ſuppoſe it would yield no vinous, but an acid ſpirit; tho' for want of vineyards in *England*, I could not examine any liquor taken out of great veſſels of muſt, and therefore cannot ſay, preciſely and experimentally, what diſtill'd liquors it wou'd afford; ſince I know not, certainly, whether the large quantity of the ſweet liquor, and its continuance for ſome time in the ſtate of what they call muſt, may not ſomewhat alter its productions; but if, as it is probable, that diverſity be not conſiderable, I may ſafely ſuppoſe the vinous ſpirit, afforded by the juice of grapes, after fermentation has turn'd it into wine, is a produced thing, and was not in that form pre-exiſtent in the juice; for having purpoſely cauſed ripe grapes to be moderately preſs'd, that the juice might, without much

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymistry.

colour like that of the expos'd filings. The *Caput mortuum* of the distill'd wine I found a more fix'd body than one wou'd have expected: and tho' probably the finer part belonging to the juice of grapes, being attenuated and subtiliz'd, was changed into an ardent spirit, and therefore appeared not in the distillation in the form of oil; yet 'tis not unlikely, that the courser part of the oleaginous substance remained still in the *Caput mortuum*; for holding it in the flame of a candle, I observ'd, that it wou'd partly exhale in thick smoke, partly melt, and as it were fry, and partly burn with an actual flame, which was not only continued while that of the candle cherish'd it, but wou'd, after it was removed from thence, continue to flame for a considerable time: and a parcel of it being cast upon quick coals, burned with a blaze, almost as if it had been amber or bitumen.

A volatile or urinous spirit from the juice of grapes.

To return to our juice of grapes; we see, merely, by a slight difference, in point of management, it may be made to afford either a vinous or acid spirit: and I shall now add, that it may be brought to yield a volatile or urinous one; for 'tis known, that, in process of time, wine affords tartar; and tho' chymists suppose the spirit of tartar to be of a quite different nature from that of urine and of soot; and tho' tartar distill'd in the common way, affords an acid spirit, and another that I call anonymous; yet, by a peculiar and slow way of operating, I have been able to obtain from crude tartar, without any addition, a spirituous substance, that in tast, smell, and several manifest operations, much more resembled the volatile spirit of soot, obtain'd as mine of tartar was, by mere distillation, than an acid spirit; with which it was disposed to make a conflict as soon as they were put together. But such a kind of volatile substance may be, far more easily, obtain'd from the lees of wine, than from tartar; for having been informed, that an expert chymist, in *Germany*, had found the way to get much volatile salt from lees of wine, I resolv'd to try whether it might not be done without any addition; and having procured some of the best lees of *Rhenish* wine, I caus'd them to be exposed in broad vessels to the sun, and the free air, that they might leisurely dry, if not also be impregnated, in order to the volatility of their saline parts. Then these dry'd feces being carefully distill'd in a retort, by degrees of fire, the liquor was slowly rectified; by which means there ascended, before the phlegm, a spirituous part, which wou'd turn syrup of violets green, precipitate dissolv'd sublimate into a white powder, soon colour it self upon copper with a deep blue, &c. from whence we may infer, that the same matter, as it is differently managed, may be made to afford an acid, and one we call anonymous, an acetous, a vinous, and a volatile spirit.

Observations upon a new anonymous spirit.

And here I will relate some of the more expeditious and easy tryals that I have made about that kind of liquors, which I styled anonymous; because when I first separated them from the acid spirits, wherewith chymists had before confounded them, their properties were ve-

very little known to me; but having ſince found them to differ in ſeveral qualities from vinous, from acid, and from urinous ſpirits; and having not ſufficiently diſcover'd their poſitive properties, I call each the neutral, or adiaphorous ſpirit of the body that affords it. * *Chymiſtry.*

But 'tis here proper to premiſe a few things in the general. 1. Our adiaphorous ſpirit may be obtained, by diſtilling the liquor afforded by woods, and ſeveral other bodies, from coral, or calcined lead; for by this means the acid corpuſcles of the menſtruum will work upon the coral, or the lead, and ſo faſten themſelves to what they corrode, as eaſily to part with the adiaphorous ſpirits, which are thus permitted to aſcend, by themſelves, and fall into the receiver in the form of a liquor. I endeavoured to try, whether there was any difference in gravity or fixedneſs, between the acid and neutral ſpirit of wood, without mortifying the former; and whether, by the help of this gravity and fixedneſs, I could ſeparate the acid from the other, and ſo preſerve it diſtinct.

In order to this, I cauſed a quantity of the rectified ſpirit of box, to be ſlowly diſtill'd in a glaſs body and head, placed in ſand, with the flame of a lamp; and in the firſt 24 hours, obtain'd but about two ſpoonfuls of liquor; and tho' the menſtruum firſt put in, ſcarce exceeded a pound, yet it was ſeveral days and nights in drawing over. And in the operation, the liquor that firſt aſcended was not phlegm, but had a very piercing taſt; yet without any manifeſt acidity diſcoverable

* 'Tis obſerved by M. *Homberg*, that towards the concluſion of the analyſis of a plant, unfermented, there uſually comes over a certain liquor, which appears to be both an alkali, and an acid; for it makes a ſtrong ebullition with ſpirit of ſalt, and changes the tincture of turnſol red. To examine into this phenomenon, he ſeparately diſtilled two plants, the one abounding in volatile ſalt, the other in acid; and rectifying the acid of the one, till it reſembled diſtilled vinegar; and purifying the ſalt of the other, he plentifully diſſolved of this ſalt in its urinous ſpirit. Then mixing the two together, no ebullition enſued; tho' they would both, apart, make a very great efferveſcence, the one with ſpirit of ſalt, and the other with oil of tartar: and long continuing thus quietly together, he had a deſire to ſeparate them by diſtillation; but a very gentle heat firſt raiſed a liquor lightly urinous, and at length there aſcended a white, cryſtalline, ſaline ſalt, that yielded ſomething of an urinous ſcent. This increaſed his wonder; for ſuch a volatile ſalt from plants he thought a new thing in chymiſtry. This ingenious gentleman, afterwards poured about ſix parts of diſtilled vinegar, upon one of ſpirit of urine, well ſaturated with ſalt, and no efferveſcence, nor ebullition enſued: and theſe were diſtill'd in the ſame manner, with the ſame effect as the former. Hence M. *Homberg* concludes, that there is a certain proportion of force required to make an acid work upon an alkali. For, in theſe caſes, the acid is on one ſide too weak, and the alkali too ſtrong. A vegetable acid, he ſays, is a *Sal terræ*, attracted by the plant, ground, broke to pieces, and weaken'd in the circulations and fermentations it undergoes therein; but, that a ſtrong ſpirit of urine, well impregnated with volatile ſalt, muſt be full of ſolid, maſſy parts, which lying cloſe by one another, are not to be ſeparated by a ſmall force. And, accordingly, a mineral acid, which has never been weakened like the other, eagerly falls upon that ſpirit of urine, and ſo will the vegetable acid too, if the urinous ſpirit be ſufficiently diluted and weaken'd with phlegm. See *Mémoir. de l' Acad.* A. 1701. *p.* 288.

Chymiſtry. by the tongue, tho' by putting it upon fine powder of coral, it had ſome operation, that made me think it not wholly void of acid particles. And having often ſhifted the receiver, the better to judge whether the portions of the aſcending ſpirit were conſiderably different in quantity, I found the liquor that came over towards the latter end, ſharper than before: and having, at length, diſtilled all I could make riſe, we found the laſt parcel to be of a good yellow colour, tho' thoſe that preceded it were limpid; and this was in ſcent ſtrong of vinegar, and to taſt more acid than ſpirit of common vinegar; ſo that had I not known how it was obtained, I ſhould have ſuſpected it to be *Acetum radicatum*; and, accordingly, I found it to be a very active menſtruum in the diſſolution of ſome bodies, that, for trial ſake, were put into it. Now all this ſeems to argue, that the acid portion of ſuch diſtilled liquors, is more ponderous, or more fixed, than the adiaphorous ſpirit, which, upon that account, may be, in great part, ſeparated from it by bare diſtillation, if carefully performed.

2. I have obſerved theſe neutral ſpirits to be not, all of them, in every reſpect, of the ſame nature; for tho' they agree in ſome general properties, which entitle them to the ſame ſpecies or denomination, yet they ſometimes differ from one another in particular qualities. It muſt not, therefore, be thought ſtrange, if ſome of the experiments I ſhall ſet down, do not punctually ſucceed in their hands, who ſhall not make uſe of the anonymous ſpirit of box, which I employed; for when I ſpeak of an adiaphorous ſpirit in general, I mean the ſpirit of box; which I had freed from its acid part, by diſtilling it from calcined coral.

3. Tho' the few chymiſts, who have taken notice of the diſtilled liquors of woods, for example, look upon them, by reaſon of their acid taſts, as merely acetous, and accordingly call them the vinegars, or acetous ſpirits of wood; yet, really, the acid portion of theſe diſtilled liquors, is far from being the greateſt. For, beſides what other trials I have made to ſhew this, I took eight ounces of the rectified ſpirit of box, wherein the acetous and neutral ſpirit remained confounded, as they had been in the firſt diſtillation; and having poured this upon a quantity of calcined coral, ſufficient to ſatiate the acid corpuſcles, which quickly fell to corrode it with noiſe and bubbles, we gently diſtill'd it, to a dryneſs, in a glaſs head and body; by which means we obtained of adiaphorous ſpirit very near ſeven ounces and a half: and ſome of the menſtruum being waſted in the operation, the acid corpuſcles remaining in the bottom with the coral they had corroded, weighed but between two and three drams; which ſhews, that notwithſtanding the conſiderable quantity of ſtrong ſpirit of vinegar, that the diſtill'd liquor of box contains, the corpuſcles that make it ſo acid being concentred, take up but little ſpace. And as it was rational to ſuſpect, that the acetous corpuſcles, being made without fermentation, might have ſomething peculiar in their nature, I cauſed them

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Chymistry. salt, that seemed to have been first dissolv'd, and then coagulated again in new figures.

(5.) Our adiaphorous liquor being confounded with highly rectified spirit of wine, neither of them appeared, considerably, to change their colour; there only appeared a small tendency to a yellow, or to grow opake by their conjunction, even after some days digesting; but the vinous spirit did not hinder the other from turning red, by the action of some strong acid, when poured on the mixture.

(6.) Rectified spirit of urine, put to our adiaphorous liquor, did not make any conflict, but joined quietly, with it, or manifestly change the colour of either, whilst they were kept many hours in the cold; but being transferr'd into a digestive furnace, and there detain'd for a night or two, the liquor acquir'd a high colour, which was almost orange-brown; and there appeared some little feces at the bottom. Having made these tryals upon our spirit with simple liquors, I thought fit to make some with such compounded ones, as the solution of metals; to see, tho' it were neither, manifestly, of an acid, an urinous, or a lixiviate nature, if it would precipitate any part of the dissolved metals.

(7.) To prosecute this inquiry, I drop'd into some of our spirit, a little solution of refined gold, which, at first, imparted its own colour thereto; but the mixture quickly lost its transparency, and grew muddy, and, after a while, let fall a considerable quantity of sediment, or precipitate; the upper liquor having acquired a brownish colour.

(8.) Having mix'd our spirit with a good solution of crude lead, made with an appropriated menstruum, that dissolves it readily, and clear, almost as *Aqua fortis* does common silver; the mixture presently became muddy, and after some days let fall a large sediment, over which swam a liquor between brown and red.

(9.) We put to our spirit of box, some fine blue solution of copper, made with an urinous spirit; and soon perceiv'd the mixture to grow turbid, which afforded us, tho' but very slowly, a plentiful residence.

(10.) We mixed with the same spirit a convenient quantity of strong infusion of sublimate, made in fair water; but found not any manifest action between those liquors, no more than between dry and undissolved sublimate, and the same spirit, when we kept them together, in this same vial.

(11.) Mixing our spirit with oil of tartar *per deliquium*, there did not, suddenly, appear any manifest change; but having digested the mixture for several days, there precipitated a light feculency, whilst the upper liquor, which was transparent, appear'd of a colour inclinable to red.

(12.) We, also, mingled with some of it a convenient quantity of vitriol of copper, dissolv'd in fair water, till the liquor seem'd satiated

ted with the vitriol ; but I remember not that, in ſeveral days, the ſolution grew manifeſtly opake or diſcolour'd. *Chymiſtry.*

(13.) We put to our ſpirit a ſolution of tin, made in a menſtruum that diſſolves it clear ; but very little alteration enſued, tho' we left the liquors for many hours together.

(14.) But, when I put to our ſpirit a convenient quantity of the ſolution of mercury, made in *Aqua fortis*, the colour of the mixture became firſt deeply yellow ; and, in a minute or two, intenſely red ; and being digeſted for ſome days, I found, at the bottom of the vial, a white precipitate, much larger than I expected ; and the tranſparent liquor that ſwam above it, was of a rich golden colour. Whether phyſicians or ſurgeons ſhou'd apply this precipitate, or tinged liquor, to medicinal purpoſes, I ſhall leave them to conſider.

(15.) Several of the foregoing experiments were try'd with the ſpirits of other woods, beſides box, and in particular, with thoſe of oak and guaiacum ; the phenomena whereof were not, always, the ſame with thoſe above recited ; which may, probably, argue ſome difference in the nature of ſuch ſpirits, as there is in the conſtitution of the woods that afforded them.

(16.) Having put of our neutral ſpirit upon ſome pieces of fine red coral, and kept them together for many days, the liquor did not appear to have extracted any tincture from them ; tho' the upper part of the highed fragments ſeem'd to be turn'd white.

(17.) And, laſtly, taking a parcel of this ſpirit, that came over by rectification, in a lamp-furnace, long before the more fixed acetous ſpirit aſcended, I expoſed a vial, ſcarce half full of it, in a very ſharp froſty night, in a garden covered with ſnow and ice ; but it was taken up, the next morning, not all frozen, tho' leſs limpid than before ; and thus it continued, either in a greater or leſs degree, for ſome weeks after.

SECT. III.

THE ſubſtances which chymiſts call the ſulphurs of the mixed bodies, that, by the help of the fire afford them, are not of ſo uniform a nature as might be expected in the portions of the ſame principle. For, as on the one hand, they make inflammability the conſtituent character of ſulphur ; ſo on the other, 'tis obvious, that there are, at leaſt, three ſubſtances, manifeſtly different in conſiſtence, texture, or both, which, according to that notion, ought to be referr'd to ſulphur. For ſometimes the inflammable ſubſtance, obtained from a mixed body, by means of fire, appears in the form of an oil, that will not mix with water ; ſometimes in the form of an inflam- *That ſulphurs are producible.*

Chymiſtry. inflammable ſpirit, which will readily unite with that liquor; and ſometimes, alſo, in the form of a conſiſtent body, almoſt like common ſulphur.

'Tis not, however, impoſſible, that in moſt mix'd bodies, what is called ſulphur, may be no primordial ingredient, but rather a generated or reſulting thing. For what is common to theſe different bodies, which paſs under the name of ſulphurs, and is the eſſential quality that diſcriminates them from the other material principles of mixed bodies, muſt be confeſs'd, if we will ſpeak intelligibly, to be a diſpoſition to be turn'd into fire, and uſually, alſo, into flame. But ſulphur, it ſelf, is made of the ſame univerſal matter whereof other bodies conſiſt, and is only a coalition of certain particles thereof; whoſe aggregate, by having a particular texture, motion, *&c.* acquires thoſe properties, on whoſe account it is called ſulphur. And, therefore, if the like texture be found in other portions of matter; or if art and chance can frame, and bring together particles of matter, and give them ſuch a texture, as diſpoſes them to be kindled, and flame, or burn away; theſe qualifications of ſuch an aggregate of corpuſcles, entitle it to the nature of a ſulphur; whether this portion of matter conſiſt, or largely participate of the chymiſts primeval ſulphur or no. For, it is not by virtue of the long duration of a thing, but by the eſſential qualities belonging to it, that a body deſerves its denomination. Thus, the ſnow that fell yeſterday, and was generated inſtantly, is as true ſnow, as that which has lain for many years on the *Alps.* And, in the judgment of the chymiſts themſelves, a pound of quick-ſilver newly tranſmuted, by a grain or two of their elixir, into gold, becomes as true gold as that which was coeval with the moſt ancient mines of that metal.

Shewn in oils. That 'tis not neceſſary the oil or ſulphur, obtained, by the fire, from mixed bodies, ſhould be a primeval element, or principle, may be probably argued from the growth of plants, fed merely by water; which nevertheleſs afford an oil in diſtillation. And, we ſee, that in almond-trees, walnut-trees, *&c.* the rain water, which inſinuates it-ſelf into their roots, is, by ſucceſſive changes of texture, reduced into the oil, which the fruit, by expreſſion, ſo plentifully afford. And, to obviate the ſuſpicion, of common waters being impregnated with the groſſer juices of the earth, I employ'd diſtill'd water to nouriſh a plant.

A ſprig of mint, put into rain-water diſtill'd, and fed, almoſt wholly, with re-diſtilled rain-water, weighed, at firſt, three grains; and being taken out when it had grown leſs than a month, weigh'd, after it was well dry'd with paper and a cloth, ten grains and about a quarter: Another ſprig, put in and taken out at the ſame time with the former, had attain'd to near four times its firſt weight; and ſhot out a ſecond ſprig much higher than the firſt, and many roots, ſome of them near as long again as the whole plant when it was firſt put in.

If

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry. Some odd properties of this oil make it ſeem likely to participate of the nobler parts of vitriol; and the ſulphur of that having extraordinary virtues aſcribed to it, by ſome of the moſt famous and intelligent chymiſts, I kept a quantity of this oil, for ſeveral years, to obſerve the alterations that time would produce in it; and afterwards I imparted the medicine; the firſt trial whereof proved very ſucceſsful.

And tho' chymiſts ſhould prove, that our oil was but ſeparated from the ſpirit of wine, or the oil of vitriol, in which it was latent before; the experiment would ſtill afford a conſiderable reaſon for queſtioning a principal point in the vulgar chymical doctrine; wherein 'tis confidently pretended, that, from the number of ſuppoſed ſimilar ſubſtances afforded by a mix'd body, it was actually compounded of a ſet number of diſtinct and true material principles, and a determinate quanity of each. For if from a diſtilled liquor, as the oil of vitriol, or from alcohol of wine, which is commonly reputed uncompounded, a liquor of quite another kind may be ſeparated; how little reaſon have we to take it for granted, that every diſtilled liquor, ſuppoſed one of the component principles of the body that afforded it, is a homogeneous ſubſtance, not further diviſible into different parts?

And in conſiſtent ſulphurs. As for the production of that kind of ſulphur, which goes under the name of inflammable ſpirits, it is ſufficiently conſidered in treating of vinous ſpirits. But what I have hitherto ſaid, indeed, relates only to inflammable liquors; whilſt it may be pretended, that ſulphur, in its proper and primary acceptation, ſignifies a mineral body. But, as we formerly ſaid, the chymiſts uſe the term ſulphur ſo ambiguouſly, that 'tis hard to avoid the confuſion which they ſeem to have affected; yet, becauſe the moſt intelligible and particular notion their writings ſuggeſt of ſulphur is, that 'tis a combuſtible and inflammable principle, I have hitherto treated of it as ſuch. And as for that ſubſtance which is commonly known by the name of ſulphur, tho' there are chymiſts, who have affirmed they can ſeparate ſuch a ſulphur from vegetables and animals; yet ſince they teach us not the way of doing it, nor give us any proofs, beſides their own words, that they have done it themſelves, the thing has ſeemed improbable to the more judicious of their own party; only a follower of *Glauber* I find to have undertaken, by his maſter's directions, to produce a real ſulphur, like the mineral, out of vegetable charcoal, by a way, which, becauſe, it has deceived more than him, and is ſpecious enough to impoſe upon the leſs cautious, I ſhall here ſet down and examine, as I made it after the author.

We took equal quantities of good oil of vitriol, and of common ſea-ſalt, diſſolved in as much water as was requiſite: this mixture we ſlowly diſtilled, till the bottom was thoroughly dry; then ſetting aſide the liquor, we took out the *Caput mortuum*, and having beat it to powder, with $\frac{1}{4}$ or $\frac{1}{8}$ part of its weight of charcoal, we put in a ſtrong crucible, and kept the mixture melted in a vehement fire, till it

grew

grew of a dark, reddish colour: by this time such a change was made in the mass, that it both smelt and tasted rank of sulphur; and if spirit of sal-armoniac were seasonably distill'd from it, with a moderate fire, the ascending spirit would be manifestly impregnated with sulphur, that was easily separable; which may also be by several other ways obtained from the same fixed *Caput mortuum*.

I do not, however, take the sulphur thus produced, to have been the vegetable sulphur of charcoal, but a mineral one, that lay conceal'd, in a liquid form, among the saline parts of the oil of vitriol.

For 'tis not likely, that so small a quantity of charcoal as was employ'd in this experiment; and much less, that so small a quantity as may suffice to make it, can contain so much sulphur, as might this way be obtained.

And that common vitriol is not destitute of mineral sulphur, appears from the sulphureousness of the marcasites whereof 'tis usually made. So that in several countries, as about *Liege*, and in some parts of *Italy*, from the same substance that affords vitriol, they obtain, by distillation, great quantities of common sulphur, which is sold for such to other countries. And I have found, that there may be obtained from vitriol, an oil, and a *Caput mortuum*, which, put together, afford an intolerable scent of common sulphur.

And I have, several times, purposely try'd, that by distilling together common oil of turpentine, and common oil of vitriol, the former of those liquors would make a separation of some of the sulphur, that lay concealed in the latter, and as it were extract it; so that, besides an exceedingly sulphureous liquor, which was sometimes made white by the dissolved sulphur that pass'd into the receiver, we had in the neck of the retort, a yellowish, solid body; which being put upon quick-coals, would, after a little yellow flame, afford much bluish flame, like that of common sulphur, which it also resembled in smell. And such a kind of sulphur I have also seen, in tract of time, settle it self, in considerable quantities, at the bottom of the liquor distilled from the mixture of the two oils above mentioned. Nor are these the only ways by which I have obtained from oil of vitriol manifest proofs of its containing a mineral sulphur, very like the common sort.

And, in particular, I once put into a retort, one part of running mercury, and four of oil of vitriol; and having distill'd off the menstruum by degrees of fire, there remained at the bottom of the glass a very white powder; which being afterwards gradually urged with a stronger fire, afforded, in the upper part of the retort, a great many small bodies, that looked like half beads of amber. These, by their aptness to melt, by their smell, and by the bluish flame they afforded when burnt, appeared to be a kind of sulphur; which seems far more unlikely to have proceeded from so homogeneous a body as quick-silver, than from the oil of vitriol; wherein we have shewn

Chymiſtry. there are many ſulphureous as well as acid corpuſcles. And as upon uniting the oils of turpentine and of vitriol in a due proportion, I conſtantly obſerved, that they incorporated into a mixture that was deeply red; I ſuſpected the chymical cauſe of this phenomenon might be, that the oil of turpentine made a ſolution of ſeveral ſulphureous particles it met with in the oil of vitriol; as we ſee that common flowers of ſulphur give a redneſs to the oil of turpentine, when diſſolv'd therein. And accordingly I found, that ſeveral other chymical oils, and even oil of aniſeeds, wou'd preſently acquire the ſame colour, when carefully incorporated with a due quantity of oil of vitriol.

As to the ſulphurs of metals and minerals, I confeſs I have not yet found enough, either in chymical writings, or my own experience, to let me ſpeak poſitively about them. It may be doubted, whether the ſulphurs that are ſometimes obtainable from minerals, belong'd to thoſe minerals, as eſſential ingredients; or were only corpuſcles of common ſulphur, perhaps a little alter'd, and mingled in the bowels of the earth, with other parts eſſential to the mineral. Thus we ſee in native cinnabar, the mercury which chymiſts ſuppoſe a compleat metal of it ſelf, is ſo mix'd with another body, as not to be, diſtinctly, diſcernible till ſeparated by the fire. And from this cinnabar I have, ſometimes, by an eaſy way, obtain'd a ſulphur. Since alſo, as we lately noted, the vitriolate marcaſites afford much common ſulphur by a groſs method of ſeparation, it ſhou'd ſeem probable, that ſome common ſulphur may remain more cloſely mix'd with the ſaline and metalline parts of the vitriol, afforded by the ſame marcaſites; from which latent corpuſcles of ſulphur may, in part, proceed the ſulphureous ſmell, *&c.* obſerv'd in vitriol and its oil. And, perhaps, the ſame conſideration may account for the ſulphureous qualities ſometimes found in the liquors that paſs for the vinegars of mineral bodies; and particularly antimony; to which may, now and then, be added ſome metalline ores; for I have had ſuch a ſulphureous liquor from good lead-ore, dug out of the mine at *Mine-deep*. And that nature her ſelf may blend an imperfect mineral with lead, I have obſerved in an ore of a mine ſo different from the other ores of the ſame country, that I did but diffidently gueſs 'twas a natural mixture of lead and antimony, till particular tryals had juſtified my ſuſpicions.

But tho' chymiſts pretend to teach us ways of extracting the true ſulphurs of minerals and metals; and tho' I know, from experience, that a real combuſtible ſulphur may be, in a conſiderable quantity, obtained from antimony; yet chymiſts often deceive themſelves and others, by miſtaking thoſe things for the true ſulphurs of minerals and metals, that really are not ſo. Of this I ſhall give a plain inſtance, in the preparation that many of them deliver of the ſulphur of antimony. For when they have boiled that mineral in a ſtrong lixivium

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Chymiſtry.

mon ſulphur: and this is not the only way whereby we have obtain'd ſuch a ſubſtance from crude antimony, which has yielded us a yellow and combuſtible ſulphur, even without the help of a menſtruum. *Paracelſus*, indeed, pretends to a way of drawing ſulphurs from all metals; but becauſe I am not able to reduce it to practice, nor clearly to underſtand his meaning, and the true nature of the inſtruments he wou'd have employ'd, I will not take upon me to determine, whether the ſulphurs he teaches to be obtainable, by this method, be genuine, and fit to decide the preſent queſtion.

However, we have ſometimes by cementing very thin plates of a certain metal with burn'd alum, and afterwards dexterouſly elevating the more diſpos'd parts with ſal-armoniac, obtain'd a ſublimate, from whence we ſeparated, by ablution with fair water, that diſſolved the ſalt, a ſubſtance, which, by its inflammability, appeared a kind of metalline ſulphur.

But, probably, even this ſort of bodies, drawn from a metal, and from antimony, may not be the effects of a bare ſeparation of pre-exiſtent ſulphur, from the other ingredients of the ſubſtances that yielded them; but new concretes, produc'd by the operation of the fire on thoſe bodies, and by the combination of ſome of their parts with thoſe of the addition, employed to obtain the ſulphurs. For, as far as I have yet ſeen, either ſalt-petre, crude or diſtill'd, menſtruums made of it, other kinds of ſalts, or oleaginous liquors, are employ'd on theſe occaſions. And 'tis very poſſible, that ſome of the more diſpoſed parts of them may aſſociate with thoſe of the mineral or metal, to be wrought upon; and ſo from this combination of the ingredients, there may reſult a body of a new texture, which texture may diſpoſe it to be combuſtible or inflammable, whether the ingredients, in there ſeparate condition, were ſo or not. Thus tho' *Aqua fortis* be not inflammable, nor a piece of crude copper inflammable or combuſtible in a common moderate fire; yet the metal being diſſolv'd in *Aqua fortis*, and the ſuperfluous moiſture warily exhaled, there will remain a fuſible concrete, wherein the copper, being much comminuted, and its ſmall parts fitly aſſociated with the ſaline ones of the menſtruum, compoſes a kind of vitriol, that, being held in the flame of a candle, or even of a piece of paper, will readily burn away in a finely colour'd flame, which may be kept diſtinct from the other.

In ſhort, it ſeems not improbable, that, if any of the metals be, by a fit menſtruum, or proper ingredient, reduc'd to parts minute enough, and theſe parts be fitly aſſociated with ſome of thoſe of the menſtruum, the metal may, thereby, be brought to burn or flame; as I have ſucceſsfully tryed upon gold it ſelf, whoſe ſulphur the chymiſts wou'd have us look upon as incombuſtible; ſo that for ought yet appears, 'tis allowable to ſuſpect, that the ſulphur obtain'd from a particular metal, is not ſo much an elementary or hypoſtatical principle, barely

barely extracted, as a magiſtery, or ſome other new compound, made by the combination of the metalline particles, with the body that works on them. But if a chymiſt will have metalline preparations of this kind, to be ſulphurs, I may be allowed to make them ſerve for inſtances of the producibleneſs of ſulphurs. *Chymiſtry.*

SECT. IV.

CHYMISTS have given us no ſettled notion of their mercury, but have left us to gueſs what they mean by it. That which ſeems agreed on by moſt of them, when they ſpeak a little intelligibly of the principle mercury, is, that 'tis a fluid ſubſtance, or volatile liquor, which therefore may be diſtinguiſhed from the ſaline principle, eſpecially from the alkaline, or fixed ſalt; as it may alſo be from the oil or ſulphur, by its not being inflammable. But theſe marks will not diſcriminate it from phlegm, which is alſo a fugitive and uninflammable liquor; and therefore to make the difference, they muſt add ſome other quality, ſuch as taſt, which is wanting in phlegm. So that, according to this doctrine, the nature of a chymical mercury, or ſpirit, will conſiſt in its being a volatile liquor, not inflammable, like oil or ſulphur, nor yet inſipid like phlegm. But what a principle muſt this be, that comprizes ſuch different bodies, as acid ſpirits, as thoſe of nitre and vitriol; the urinous, as for inſtance, thoſe of blood, hartſhorn, *&c.* and the anonymous, as thoſe of guaiacum, honey, *&c.* freed from their acidity; and the running mercuries of minerals and metals, as cinnabar, antimony, and lead? But as for the mercuries, or uninflammable ſpirits of vegetables, and animals, I have endeavour'd to ſhew their production, in treating of ſpirits and volatile ſalts. And, therefore, I need only now ſpeak to the production of mercury, more properly ſo called, that is, running mercury. *Mercuries producible.*

That there may be extracted, or obtained from metals and minerals, a fluid ſubſtance, in the form of running mercury, is the common opinion of chymiſts; and in their writings we may meet with many proceſſes to make theſe mercuries. *Whether running mercuries are obtainable from metals and minerals.*

But ſeveral of the more learned chymiſts themſelves, have look'd upon the pretenſions of others to the art of making them, as a chimera; and ſome judicious modern writers have exploded all theſe mercuries of bodies as meer non-entities; nay, ſome do not ſcruple to cenſure all thoſe who pretend to have ſeen, or made any of them, as credulous, or impoſtors.

I here propoſe to examine, whether from a metal, or mineral, there may, without the addition of any ſubſtance, that certainly contains common quick-ſilver, be obtained, by art, a ſubſtance reſembling that drug

Chymiſtry. drug in weight and fluidity, in amalgamating with gold, and ſome other metals, and in being indiſpoſed to wet or ſtick to bodies, that are not of a metalline nature.

Now there are ſeveral proceſſes of making the mercuries of bodies, ſo darkly deliver'd, that the generality of chymiſts cannot underſtand them, ſo as to put them in practice.

For ſome of theſe proceſſes are ſet down in terms of art, which, for their great darkneſs or ambiguity, are utterly unintelligible, but by the authors themſelves, or thoſe who are vers'd in the more myſterious parts of hermetic philoſophy. And others there are of theſe proceſſes, that require ſome menſtruum, ſalts, or other inſtruments, not in the power of ordinary chymiſts to procure.

Inſtances of this kind frequently occur in the writings of ſuch as paſs for the adept philoſophers; for inſtance, in *Lully*'s method of making mercury of ſilver; *Helmont*'s way of preparing mercury of lead; and *Paracelſus*'s way of extracting the mercuries of all metals.

Again; there are ſeveral proceſſes to make mercuries of bodies, either falſe, or attended with ſuch circumſtances, as render them unfit to be truſted.

Some of theſe having been cautiouſly try'd, by thoſe who had a great deſire to find them true, have not ſucceeded at all in practice. Hence we have ſo many complaints of ſuch chymiſts as have loſt their labour in endeavouring to make, according to *Beguinus*'s directions, the mercury of ſilver; tho' I do not take that to be one of the moſt difficult to be prepared: and he who converſes with thoſe who have attempted to make the mercuries of gold, antimony, *&c.* according to the vulgar proceſſes, will find, by their confeſſions, how little the event has anſwer'd their expectations. Nor do all the manuſcript proceſſes, communicated to private friends as great arcana, much excel the other; as ſeveral of my acquaintance have found to their coſt. Among the many chymiſts I have known, I remember not above three or four credible perſons who would affirm, they had ever prepared the mercury of any metal or mineral, except of native cinnabar, which is the natural ore of quick-ſilver; or ſeen it made, in a conſtant way, by any proceſs found in printed books. So many of theſe methods having, therefore, upon trial, been found falſe; cautious men may be excuſed believing other proceſſes for making mercury, which, tho' not yet try'd, ſeem no more probable, than thoſe that have been found unſucceſsful.

But farther; there are ſome proceſſes, wherein it is thought, that the mercury of a metal, or mineral, is obtained, when, indeed, the produced ſubſtance is miſcall'd; or the true mercury ſaid to be extracted, was put in diſguiz'd by the operator.

I will not here give inſtances of the cheats that may be put upon the ignorant and unwary, and ſometimes too upon the ſkilful, if they be not cautious; but ſhall content my ſelf with a few innocent examples.

And

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Chymistry. and this invited him to apply himself to me, hoping to find a remedy for this inconvenience.

A fellow-traveller of mine, employing a saline body about lead; after he had finished his operation, left the lead and salt together, for some months, in a vessel, which he laid by in a garret, where the air had access to it; and he afterwards found, to his wonder, that tho' he had employed no mercurial body to work upon the lead, yet part of it was turned into quick-silver, separable by straining; and more seemed in a ready disposition to undergo the like change. Whereupon he brought me a part of the metal, and a little of the mercury, which I found, by experience on gold, to be of a nobler kind than common mercury. And I the less wonder'd at this phenomenon, because, by examining the gentleman, I discover'd, that the principal thing he employed in the operation was common salt.

We took three ounces of well refined silver, in thin plates, and six of common sublimate, which was put first into a retort; the silver cut into small pieces, being laid uppermost, that it might be penetrated by the ascending fumes: but the fire having not been made strong enough, the sublimate was elevated to the upper part of the retort, and left the silver scarce at all chang'd in the bottom of the glass. Wherefore, we put the same sublimate and metal into another retort, and applying a stronger fire, that the sublimate might be thoroughly melted before it could fly away, we obtained no running mercury at all; but the greatest part of the sublimate was elevated in its usual form; leaving behind it, the silver in a lump, which stuck hard to the bottom of the glass, and appeared much alter'd. It had gained an ounce in weight, and many pieces of the metal stuck together, and seemed at least half melted; and were of a kind of horny and semi-diaphanous substance, which would readily melt, almost like sealing-wax; when held to the flame of a candle, at which yet I could not perceive it manifestly to take fire.

An expert metallist of my acquaintance, being desirous to try what gold and silver he could get out of a fine *English* marcasite I had presented him; he examined it, according to his method, without any mercurial preparation, and found, to his surprize, that it yielded, besides other things, some running mercury, which he gave me.

Metalline mercuries produce heat in mixing with gold.

More than one of my friends have made the mercury of antimony, by unsuspected additions, such as salts, that had nothing to do with sublimate, or other compositions, wherein common mercury is an ingredient. One of these antimonial mercuries looked so odly, that, tho' it were made by distillation, I try'd whether it would not operate on gold in a peculiar manner; and having, accordingly, put a little fine calx of that metal into the palm of my hand, I added to it an equal, or a double weight of this mercury, which immediately incorporated with a very manifest heat. And this is my quick way of examining other mercuries of bodies; for tho' alone it be not a certain

certain sign, that a mercury is of that sort, because I can obtain a mercury so qualified, by a different method from any hitherto mentioned; yet as I had sufficient reason to conclude, that they obtained those mercuries from the bodies they affirm'd to have yielded them, so the readiness of these mercuries to mix with gold, without the help of fire, and even to grow hot with it, which vulgar mercury will not do, confirmed that they were metalline mercuries, rather than of the same kind with common quick-silver. And my way of obtaining incalescent mercury, is so very different from any of those, that there was not the least cause to suspect, the mercuries of the respective bodies were so obtain'd; especially since I knew that my way was unknown to most of the persons mentioned, and practised by none of them.

Having prepared a particular mercury of this kind, I put to one part thereof, sometimes half its weight, and sometimes an equal weight of refined gold, reduced to a calx, or subtile powder; and mixing them together in the palm of my hand, they grew, in the space of a minute, considerably hot. The effect was by much the greater, for employing an equal weight of gold. Nor did the interposition of a paper between the metals and the hand, prevent, tho' it much abated, their heat.

These experiments were made but with small quantities of the mercury; but if we had employed larger, to a due proportion of gold, 'tis probable, the heat might have been intense enough to crack a glass vial; for a dram of it has sometimes caused me to lay it suddenly out of my hands. This mercury was so well disposed to gold, that it would presently amalgamate with an equal quantity thereof, into a hard mixture; wherein the mercury so far prevailed, as quite to abolish the colour of the gold. And the power of penetrating and growing hot with gold, was so essential to our mercury, that after it had been frequently distilled from that noble metal, it still retained this property: nay, even a single dram of it, after having lain by for three or four years, grew so hot with gold, that I feared it would have burnt my hand. And to try, whether this surprizing faculty of growing hot immediately upon gold, wou'd continue for a still longer time in the mercury; I took some that I had kept, hermetically sealed up, for ten or twelve years, and having put it to some common calx of gold in the palm of my hand, it presently grew hot: and having distilled off the mercury, and tried it again, it did, as well as some that was undistill'd, again heat with gold.

And, by the way, we may observe, that a mercury qualified to grow hot with gold, and perhaps with other powders, may be made by more methods than one or two; for experience has assured me, that such a mercury may successfully be prepared, not only by employing antimony, and such solid metals as iron, but even without any metal or antimony. But the gold must be duly prepared for this trial: The smallest filings I could procure, were not fine enough for the purpose, nor will every calx of gold serve the turn; that which

Chymistry. I principally chose, was made by quartation, or the melting together one part of fine gold, and three or four parts of cupeli'd silver, and then putting the mass, wherein the metals are mixed almost *per minima*, into purified *Aqua fortis*, which dissolving only the silver, leaves the gold in a fine calx. But there being some difficulty in obtaining this calx pure, I will add, that by making an amalgam, in the common way, with pure gold and vulgar mercury; and dissolving the mercury in good *Aqua fortis*, there will remain a powder, which being well wash'd with fair water, and kept a while in a moderate fire to dry, will become a proper calx for this purpose. And to shew, that the heat in this experiment proceeds not from the corrosive particles of the *Aqua fortis*, employed in preparing the gold; I put upon fine leaf-gold, two or three times its quantity of our mercury, and a smart heat was immediately produced in my hand. I put two drams of antimonial quick-silver into the palm of my hand, and added to it, by degrees, a dram and a half of the powder of fine silver, made by precipitation with copper, in the ordinary way; then mixing them with my finger, I found they grew sensibly warm. And this mixture, in a short time, became of a soft and uniform consistence, almost like melted butter; so that we added half a dram more calx of silver, without rendering the amalgam too stiff; and, perhaps, we might have added another half dram, without overcharging that piercing mercury; in which case it would have swallowed up full its own weight of silver: so different was it from common mercury. And when we left off, it had reduced into a very yielding form, three quarters of its own weight of solid metal. This amalgam we put into a small vial, and stopt it up with cork, to observe, whether it would harden when kept from the free air. Next morning it appeared to be concreted in the glass; and breaking the glass on the morning following, to take out the matter, we found it considerably hard and brittle.

As for the mercury of gold, tho' I have brought a great many parts of that crude metal to assume a mercurial form, and to come over therein by distillation, yet I have not seen any thing, that I was satisfied deserved to be called mercury of gold. But a foreigner, who seem'd a candid gentleman, and, as I perceived, had seen uncommon things, and who shewed me one whereat I was surprized, assured me, that he had met with a very learned man, in comparison of whom he confessed himself but a novice, who put some gold into a little vial of a certain menstruum, which this gentleman knew not how to prepare; and intimated to him, that the menstruum would have a peculiar operation, as well upon gold as silver; and my relator having put the vial, well stopp'd, into his pocket, and carried it about with him, was, when he came home, and took it out, surprized to find, instead of the gold he had seen put in, a considerable quantity of running mercury. This the artist, who only lent him the

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Chymistry. pass for mercuries. And if in the moon as there are mountains, so there shou'd also be metalline mines, in case the heat of the climate, or of the soil, shou'd keep them constantly in such a degree of heat, as we find sufficient to melt lead, which need not be very intense, these metals wou'd there imitate our mercuries. Thus I have learn'd from travellers, that in several parts of the torrid zone, what wou'd here be butter, is there fluid like oil, and sold, as other liquors, by measure; not by weight. And an inquisitive traveller assured me, that whilst he was in some parts of the *Indies*, having furnish'd himself with some liquid substances from wounded plants; as soon as he came near *Europe* they turned into consistent and pulverable bodies: it is not therefore impossible, that the piercing salts, and other subtile bodies, employed in preparing the mercuries of metals, may, either by their natural agility, and by so altering the shape, and loosing the cohesion of the metalline corpuscles, bring them to such a texture as may suffer the etherial substance, whereto so many other bodies owe their fluidity, to agitate them. These causes, or some other, may possibly keep the prepared metal fluid. Thus tho' camphire be a consistent and tough body, yet some nitrous spirits will easily penetrate it, and may be brought to stay so long with it, that I have kept the oil of camphire for several years, without loss of its fluidity, tho' expos'd to such intense degrees of cold as would freeze several other liquors. And since the vapour of lead can arrest quick-silver, and make it a consistent body; and since *Helmont* assures us, that the liquor alkahest being once abstracted from running mercury, deprives it, and that almost irrecoverably, of its fluidity, so as to make it pulverable; why may not nature or art supply some corpuscles to expel or disable those that keep a metal in the form of a solid? especially since the matter of metals themselves may have been a fluid body. Another reason why I suspect the mercuries of metals and minerals not to be merely extracted principles or ingredients, is, that I have observed a greater dissimilitude between running mercuries, furnished with all that is requisite to make them pass for true, than agrees to their being simple and primordial bodies, barely extricated from the others, with which they were at first mix'd; as we shall see hereafter. The chymists, also, who talk of the mercuries they have drawn from metals, do not tell us what other ingredients they obtain'd by their supposed analysis; which leaves it dubious, whether they obtain'd any salt or sulphur or not; and of what nature those substances were that they did obtain. For if these were not true salt and sulphur, the genuineness of the analysis might be question'd; because it may be alledg'd, that the chymical operation, and the addition, turning some parts of the earth into bodies, which must not be acknowledged to have pre-existed in them, may also, by a change of texture, have turn'd some other parts of the metal into the form of mercury.

And

Chymistry.

And to give the sanction of an adept, *Raymund Lully*, tho' he often speaks of mercury in a dark and allegorical sense, yet in his *Clavicula*, he delivers a process, from whence it seems manifest, that his design was not to extract a pre-existent quick-silver; since he directs us to prosecute the work till the quick-silver obtained, be equal in weight to the silver to be transmuted; whereby it appears, that the mercuries of bodies are rather magisteries than extracts. For in this process of *Lully* it appears not, that the mercurial principle was extracted from the salt and sulphur; but rather that the body of the metal, without being analyzed, was turn'd into mercury. Magistery is, indeed, a term variously employed by chymists, and, particularly, 'tis used by *Paracelsus*, to signify different things; but the best notion I know of it, is, that which I find authoriz'd even by *Paracelsus*, where he expresses himself more distinctly, I mean a preparation whereby there is no analysis made of the body assign'd, nor an extraction of any particular principle, but almost the whole body is turn'd into a substance of another kind: as when iron or copper, by an acid menstruum that corrodes and associates therewith, is turn'd into vitriol of iron or copper; and quick-silver, by having a sufficient quantity of *Aqua fortis*, strongly abstracted from it, is chang'd into red precipitate; or by being sublim'd with common sulphur, is turn'd into cinnabar: or to give a more apposite example, when quick-silver is, by the lasting operation of the fire, without external additions, distinct from the particles of fire, turn'd into a red powder, call'd precipitate *per se*.

I am credibly informed, and have some proof of the thing, that there is a place in *Transylvania*, where portions of running mercury falling out of the earth, and lying a while in the air, of themselves coagulate into bodies permanently hard: so little difference hath nature her self there made between the mercurial fluidity, and the solid consistence of the same portion of matter. If, therefore, so small a thing as the contact of the air can expel, is able, by its presence, to retain a mineral body in the form of a true running mercury, as well as by its recess to leave it solid; why shou'd it be impossible for art to inclose some very minute and restless particles, which, by their various and incessant motions, may keep a metalline body in the state of fluidity; as I lately noted, that the spirit of nitre, for whole years together, kept camphire in the form of a liquid oil?

But it may be objected, that quick-silver easily amalgamates with metals; because of its near alliance to the mercurial part of those bodies, and that the gravity of the metals is such, as cannot reasonably be deduced from any other cause than an abundance of the mercurial principle.

To this I answer, that amalgamation being, in effect, but a kind of dissolution of metals, in a menstruum or fluid body, for such is mercury with regard to them, there is no necessity that the solvent shou'd find, in the metal, a copious ingredient just of its own nature; for

Chymistry.

for dissolution depends not so much upon the pretended affinity between the solvent, and the body it is to work on, as upon the congruity, as to size and figure, between the pores of the latter, and the corpuscles of the former. This appears by the solution of ivory and hartshorn, that may be made with *Aqua fortis*; and of zink, and even of copper, by the spirit of vinegar, the urinous spirit of sal-armoniac, and spirit of vitriol, separately employed; tho' the first of them be a menstruum drawn from a vegetable, the second from an animal, and the third from a mineral substance. And I observe in amalgamations themselves, that the facility wherewith mercury joins to a metal, does not barely depend upon the plenty of the mercurial ingredient contained in the metal; at least if the ponderosity, or specific gravity of the metal, depend upon the quantity of the same mercurial principle or ingredient; for we find by experience, that mercury will far more easily amalgamate with tin, than with copper; which yet is much heavier than it, nay, than with silver, which is considerably heavier *in specie* than copper, and is by chymists presumed to be much nearer of kin to mercury, than is tin. And tho' iron be specifically heavier than tin, yet it is far from being more easily amalgamable with mercury; for tin will readily admit this mineral liquor, without the help of heat; but there is no way vulgarly known to make an immediate amalgamation between mercury and iron. So that either the disposition of metals to amalgamate with mercury, does not barely depend upon the supposed plenty of mercury contained in the metal; or else the greatness of the specific gravity does not depend upon the more plentiful participation of the mercurial ingredient. And as the great ponderosity of metals, in comparison of other bodies, is here supposed to proceed from the quantity of mercury they contain; it may be justly demanded, whence mercury it self derives its weight. Perhaps both in that, and in metals, 'tis owing to the solidity and close order of the corpuscles they consist of; to which qualification it is not essential, that the portion of matter endowed with them be in a state of fluidity, rather than solidity; for gold and lead are exceeding ponderous, as well in fusion, as when cold and hard: and the same holds true in quick-silver, in its liquid form, and when coagulated with the vapour of lead.

It may, again, be objected, that the mercuries of metals must needs be but partial principles of them; since quick-silver being confessedly heavier than either the sulphureous, or the saline principle, and than almost any metal; the gravity of a metal cannot reasonably be suppos'd to proceed from the whole body of it, but only from some one ingredient, heavier *in specie* than the rest, and than the metal it self. And that this ingredient, or principle, can be no other than the most ponderous body, mercury.

But there is no necessity to suppose, that metals, of what denomination soever, are bodies perfectly homogeneous, tho' they seem such to the eye; and the chymists will have metals, as well as other mix'd

bodies,

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymiſtry. Beſides, a fluid form does not always argue the lightneſs of the body wherein it is found; ſince it may conſiſt of particles ſo ſolid and numerous, that notwithſtanding their inteſtine motion, the body they compoſe may be very ponderous; as appears by red-hot iron, melted lead; and in common quick-ſilver, which, tho' fluid, is heavier than any known body except gold.

But farther, tho' the ſolid portion of a metal retain more of the additions employ'd to bring it into the form of mercury, than it can be prov'd to contain; yet, this diſadvantage may be compenſated, by the new diſpoſition of parts that the mercurial portion acquires in the operation which turns it into a liquor; and may be ſuppos'd to bring the parts to a cloſer, or more convenient order than they were in before; as ice, when thaw'd, takes up leſs room than when ſolid. And 'tis not impoſſible, that the ſpecific gravity of metalline bodies may be increas'd or diminiſhed by ſuch ſmall proportions of additions, as do not at all conſiderably add to their abſolute gravity. This the chymiſts ought not to deny, after what they grant of the efficacy of that they call the philoſopher's ſtone, whereof they tell us, that one grain, if it be of a nobler order, or degree, may tranſmute a whole pound of quick-ſilver into perfect gold; whence, conſequently, the ſpecific gravity of a metal is vaſtly chang'd by an addition. Beſides, the tranſmuting powder, being a compound body, whereof only a part is gold, it may probably be ſuppos'd to be more light *in ſpecie*, than the metal, that by addition thereof is produced; which being pure gold, is the moſt ponderous body yet known. And there is a way of making a metal far lighter *in ſpecie* than it naturally is, by the addition of leſs than a 100th part of its weight; as experience has convinc'd me.

Wherefore, to come to the grand objection drawn from *Lully*'s experiment, it will not preſently follow, that, if the whole body of a metal be brought into a mercurial form, this mercury deſtroys our hypotheſis; for tho' I grant it cannot here be ſaid, as in the former caſes, where a part only of the metal is turn'd to mercury, that the obtain'd quick-ſilver may conſiſt of the moſt ſolid and ponderous parts of the metal; yet it may ſtill be alledg'd, that, for ought we know, the mercury produc'd by the reduction of the whole metal into a fluid form, will be ſpecifically lighter than common mercury; and ſo cannot be neceſſarily concluded ſpecifically heavier than the metal that afforded it. I have, indeed, had portions of the mercuries of more than one or two metals, yet it was but in ſmall quantities; ſo that the other trials I made with them, prevented me from examining their ſpecific gravity hydroſtatically. But, that quick-ſilver may be ſpecifically lighter than the metal which affords it, the chymiſts cannot reaſonably deny; ſince they allow running mercury to be obtainable from gold; and tell us great matters of it, becauſe of its proceeding from ſo noble a body. Now, if this mercury of gold be ſaid to be of the ſame ſpecific weight with common quick-ſilver, we have a notable inſtance of a mercury conſiderably

derably lighter, *in ſpecie*, than the metal that yielded it. And therefore, till experience has manifeſted the contrary, it will not be abſurd to preſume, that the mercuries of other metals may, likewiſe, be lighter, *in ſpecie*, than the reſpective bodies from which they were obtain'd: but if it be ſaid, that this mercury of gold, may be as ponderous as gold it ſelf; then 'tis poſſible for a metalline body, notwithſtanding its being reduced into the form of a fluid, to be equiponderant to the metal that afforded it. And to confirm this, I ſhall add, that it is poſſible for a metalline body to reſemble another in all the manifeſt qualities whereby artiſts examine them; and yet to differ greatly from it in ſpecific gravity; as I once obſerved in a metal, that was not only white, like ſilver, and very malleable, but when purpoſely examined, endured cupellation, and was reputed by a very eminent artiſt, who ſent it me to examine, to be good ſilver in all proofs; and yet this metal I found, by hydroſtatical trials, to be much lighter, *in ſpecie*, than common ſilver. And if this famous perſon was not miſtaken, that odd metal may yield me a notable inſtance to my preſent purpoſe; ſince he affirm'd it to be made of quick-ſilver, without the addition of any metalline body: for if ſo, that fluid muſt, by a change of texture, have ſuffer'd a conſiderable loſs in its ſpecific gravity. And once I had a mercury, which, amongſt other remarkable properties, was conſiderably heavier, *in ſpecie*, than common mercury, tho' it were made of a body no heavier, and by the help of additions much lighter than that. This quick-ſilver looked very fine, was very agile, and had, before I examined it, been more than once diſtill'd. Hence it appears, that while a body is in a mercurial form, we cannot ſafely determine what degree of ſpecific gravity it has. For ſince a ſort of quick-ſilver may be far more ponderous than the common; 'tis probable, that another ſort may be far lighter than that; and ſo, perhaps, lighter than the metals reduced into that form: for 'tis far leſs likely, that the former ſhould be produced, than the latter; becauſe there is but one known mineral body at all heavier than common quick-ſilver; whereas there are many much lighter than it, which are capable of being aſſociated therewith.

Chymiſtry.

In ſhort, the argument I have been anſwering is not cogent, becauſe built upon a ſuppoſition, that the mercuries afforded by metals and minerals muſt be of the ſame weight with common mercury; which is a bare aſſertion, without any proof, and repugnant to the experiment juſt mentioned, of the diſtilled mercury, that was heavier than the common; and to the preſumption thence derived, that there may be bodies in a mercurial form, lighter, *in ſpecie*, than common mercury. And ſince pure gold is far more ponderous than common quick-ſilver, it plainly appears, that it is not to the participation of common mercury, that metals muſt neceſſarily owe their great weight: but that nature and art may contrive the parts of a body into ſo cloſe an order, as to make it more ponderous, bulk for bulk, than common quick-ſilver.

Chymiſtry.

And here it may be proper to inquire, whether all the bodies, that in ſhops, and among chymiſts, paſs for true running mercuries, are homogeneous, or, ſo much of one and the ſame nature, that the ſeveral portions of them differ but numerically.

Running mercuries not homogeneal.

I have ſome obſervations to make upon this queſtion, that will determine it in the negative; tho' both chymiſts and naturaliſts employ all running mercuries indifferently.

1. And, firſt, it is obſervable, that a running mercury may be brought to differ from common quick-ſilver, by depuration; for there are in moſt mercuries, either recrementitious particles, or at leaſt ſome looſe adherences, ſeparable from the reſt of the body; which being removed, the mercury becomes more homogeneous, or clean, than before. The like end is alſo obtainable, by grinding, or waſhing the mercury very well with ſalt and vinegar, or ſpirit of wine; which will commonly be foul'd by what they carry off. And mercury is ſometimes attempted to be purified by diſtillation; which, tho' in ſome caſes inſufficient, is in others very convenient. And artiſts uſe other means to the ſame purpoſe. No wonder then, if chymiſts themſelves, before they proceed to more intimate preparations of mercury, order it to be, ſeveral times, previouſly incorporated, and ſublimed with acid ſalts or ſulphurs, and then revived with alkalies; ſince, according to mechanical principles, it muſt thus be divided into exceeding minute globules; whence it acquires far more of ſurface than it had before; ſo that a great multitude of ſeparable parts come to be touch'd almoſt on every ſide by the ſalts and ſulphurs, whereto, by this means, when the quick-ſilver is driven from them in the revivification, 'tis probable, that very many of them adhere, which were not ſuperficial, when all theſe globules made up but one maſs. And, 'tis poſſible too, that the alkalies employed to revive the quick-ſilver, may help to tear off from it ſome of the feculent particles, which the chymiſts deſire it ſhould be freed from. And, by the way, there is no neceſſity to have recourſe to ſalt of tartar, or quick-lime, or ſuch like alkalies, for the reviving of quick-ſilver; and, therefore, when I would, with eaſe, obtain a clean and active mercury, I do not employ firſt acid, and then alkaline ſalts, but thoroughly mix common cinnabar, finely powder'd, with a double, or an equal weight of filings of iron, or ſteel; for theſe being diſtilled together in a low retort, with a briſk fire, the ſulphur of the cinnabar will faſten upon the filings, and let the mercury come over fair and vivid, and, perhaps, impregnated with a ferruginous quality.

2. There is, alſo, another way of diverſifying mercury by impregnation; as when ſome ſubtile parts of another body, are ſo intimately aſſociated and united therewith, that not only the addition will paſs with the mercury, when ſtrained thro' leather, but, alſo, continue with it after diſtillation, whilſt the mercury ſtill remains very vivid. I know there are many chymiſts, who look upon quick-ſilver

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Chymiſtry. I could preſently make an amalgam with one part of the calx, or leaves of gold, without any other external heat, greater than that of the palm of my hand. Nay, ſometimes, I have employ'd but one part of quick-ſilver to make a mixtrue; wherein the gold was ſo far from appearing, that the colour of the quick-ſilver ſeem'd not ſenſibly impair'd.

4. Another difference between ſome mercuries, and thoſe that are vulgar, is, that theſe being put to calx of gold, tho' they are, at length, brought to mix, yet they will not diſcloſe any ſenſible heat; but the mixture, like each of the incorporated ingredients, will to the touch ſeem cold. But I have often found, that a diſtill'd mercury may be ſo invigorated, that a ſingle dram of it, or, perhaps, a far leſs quantity, being barely mix'd by my finger, with as much, or half as much calx of gold, would preſently conceive a conſiderable heat, which would, as was formerly ſaid, ſometimes, prove offenſive to the palm of my hand, wherein I held it. And to convince a very eminent chymiſt, that there were ſuch mercuries as theſe, I took a remnant of certain quick-ſilver, of whoſe diſpoſition to incaleſcence I had ſuch an opinion, that tho' we had no calx, nor ſo much as filings of gold, but only ſuch pieces as could be obtain'd by a hammer and a pair of ſciſſers; I ventured to put it to them in a glaſs mortar, when, notwithſtanding the thickneſs and cloſeneſs of the beaten metal, and the coldneſs of the veſſel, the mercury, to the artiſt's ſurprize, penetrated the gold, and grew manifeſtly hot with it. And this faculty of our quick-ſilver was not tranſient; for I had kept this parcel of it by me for ſeveral years. The incaleſcent mercuries, hitherto mentioned, were invigorated by tedious and laborious operations; but I know, by experience, a way, tho' it be hard to hit, that will in an hour, and perhaps in leſs time, qualify mercury to grow preſently hot, tho' in a manner vaſtly inferior to the former.

5. When an invigorated mercury is, by due impregnation, qualified to amalgamate readily and intimately with gold, and penetrated ſo as preſently to grow hot therewith, it is not ſtrange that it ſhould alſo differ from common mercury, in being able to carry up with it part of the gold, wherewith it was ſo ſtrictly aſſociated. I know, 'tis often thought incredible, that crude gold ſhould be volatiliz'd by quick-ſilver; and, indeed, the common ſort may be many times diſtill'd from gold, without carrying up any of it; but with a very ſmall quantity of a mercury, ſubtilly impregnated, I have elevated ſo much calx of gold, that the inſide and neck of the retort, were richly gilt by the adherent particles of that metal, which would ſometimes ſtick ſo cloſe, as not, without difficulty, to be ſeparated from the glaſs: and having, with one of theſe noble mercuries, amalgamated about half its weight of calx of gold, tho' it did not gild the inſide of the glaſs, yet I found, that the diſtill'd mercury was manifeſtly increas'd in weight, and ſomewhat changed in colour and conſiſtence.

6. Upon

Chymistry.

6. Upon distilling an amalgam, made with one of these subtily impregnated mercuries, and the calx of gold, I have observ'd a large part of the bottom of the retort, to be left adorn'd with a very lovely colour, almost like that of a turquoise stone, inclining to yellow, and somewhat changeable; and the stain seem'd to have penetrated the glass, tho' left by a very small quantity of the amalgam; and tho' the mixture were distill'd but in a sand heat. And another amalgam of gold, with an invigorated mercury, being long decocted, the vessel broke, and left the lower part of the glass permanently ting'd with a pure and transparent red, that seem'd to resemble a fine ruby.

7. I have found another surprizing difference between ordinary quick-silver, and subtily impregnated mercuries; for tho' one would expect that mercuries so piercing, and so disposed to adhere closely to gold, should make with it amalgams, far more easy than those made with ordinary quick-silver, to be turn'd into red precipitate; yet I found the contrary upon trial. Chymists mention about six weeks, as the usual time wherein mercury may be precipitated *per se*; and allow but a shorter time, to make this precipitation, when 'tis amalgamated with gold; but I have kept invigorated mercury, amalgamated with about a third part of its weight of fine gold, for above three months, without having so much as a grain of precipitate, that I could perceive; tho' the mercury grew hot with the gold at their being mingled, and tho' the whole were kept in a heat, able to make quick-silver circulate. This I try'd with other sorts of invigorated mercury; but, in above five or six months, obtain'd not a single grain of precipitate; tho' the heat was so strong, as to carry up many parts of the quick-silver, and of the gold with it, to the top of the glasses. Nay, the fire was so violent, that one of the hermetically seal'd glasses beginning to melt, the spirituous matter, included in it, was so forcibly expanded, as to stretch the weaker side of the vessel, and make it bulge out; tho' it did not break. Nor is the space of six months, the longest term, during which I have kept gold in decoction with invigorated mercuries, without obtaining a red powder, or precipitate; so that as far as I have yet try'd, the more subtile, and richly impregnated mercuries, are far less apt to afford precipitates with gold, than common quick-silver is. As if that disposition, to be turn'd into powder, required the presence of the recrementitious, or more separable part of quick-silver, which a chymist would perhaps call its sulphur. This, I confess, was a disappointment to me; for I had hopes of making a precipitate with gold, and some of these noble and richly impregnated mercuries, that should prove a better medicine than precipitates made with gold and only common mercury; tho' even of some of these, when dexterously prepared, and kept their due time in decoction, I have seen great effects, when exhibited in a just dose, and prevented from raising a salivation.

8. The last difference I shall observe between some distill'd mercuries and common quick-silver, is their inequality in point of specific gravity.

I had

Chymistry. I had once the opportunity to examine, hydrostatically, a noble mercury, for the impregnating whereof, neither gold nor silver was employ'd, and I found it very considerably heavier, *in specie*, than common quick-silver; tho' this mercury had been several times distill'd, and by other means depurated; which to me seemed to argue, that even volatile gold is able to increase the specific gravity of mercury! And the ponderosity of this mercury seems more surprizing, because having, by the same method, examined another, made after a strange way, without common mercury, I found it scarce at all to differ in gravity from ordinary quick-silver.

And, by the way, 'tis no just inference, the heavier the mercury, the more fix'd; for having instructed a gentleman how to make an invigorated mercury, which I judg'd to be much of the like nature with our ponderous one, but less tedious, and far less difficult to prepare; this gentleman inform'd me, that in purifying and invigorating his quick-silver, he found it so alter'd and subtilized, that he could distil it in less than half the time, he had formerly employ'd to drive it over, with the like fire and vessels.

And whatever some learned chymists, and others, teach to the contrary, it is matter of fact, that mercuries may be subtily impregnated more ways than one, so as to penetrate gold very powerfully, and grow hot with it. And it seems to me very probable, that the different methods employ'd to prepare these mercuries, by impregnating them with a particular mineral or metal, may much diversify their qualities and operations, according to the respective natures of the bodies made use of. And tho' there seem so great a difference between quick-silver and vegetable substances, yet I have seen a mercury that was prepared by the help of vegetables, without metals or minerals, more noble than, and very different from common quick-silver. And as several bodies and methods may be employed in the preparation of noble mercuries, so it seems very probable, that the common mercuries, thus prepared, may have different, but noble qualities and uses, not only in chymistry, but medicine; as being fitted for powerful operations, as well upon human bodies as the more stubborn ones of metals and minerals. I am not, indeed, forward to recommend the needless use of mercurial medicines, of which we may too often see bad effects, if they be not as well prudently and cautiously given, as faithfully and skilfully prepared: but since some vulgar preparations of common mercury often prove far more efficacious than ordinary medicines, in stubborn diseases; we may, surely, hope for greater and more innocent effects from a mercury, well purify'd and impregnated with the sulphur and finer parts of such bodies, as volatile gold, copper, iron, antimony, *&c.* And tho', as I lately said, I found such mercuries much more indispos'd than common quick-silver, to make a precipitate with crude gold; yet several other preparations may be made, as well with impregnated, as with vulgar mercury; such are turbith mineral,

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymistry. I shall not here observe the different tasts of different creatures, or of the same at different times, and according as the object is applied; but methink the consideration of quick-silver may let us see, that 'tis possible for a gross and fluid body to be insipid. For quick-silver is, without question, a fluid, and in regard to some bodies, as gold, silver, &c. a liquor; since it sokes into their pores, and softens their bodies. The same quick-silver may shew, by its dispösition to fly away in the fire, that volatility, even in conjunction with insipidity, is no certain mark of an elementary or primordial body. And indeed, since volatility principally depends upon the extraordinary minuteness of the particles whereof a body consists, on their being detach'd from one another, and of shapes fitted for motion; this quality may be acquired by so many different ways, and be met with in bodies otherwise of such different natures, that unless it be found associated with the other qualities proper to phlegm, it will be but an uncertain argument to prove the body, it belongs to, elementary.

Of all the bodies employ'd in chymistry, those that seem the most indispösed to be turn'd into water, are metals and minerals; if, therefore, it can be made appear, that any of this sort are changeable into an aqueous liquor, 'twill be highly probable, that aqueous liquors may, by chymical operations, be produced, especially in vegetable and animal bodies, which seem far more susceptible of such a change, than the stubborn subjects of the mineral kingdom. And since quick-silver is generally allowed to be one of the most indestructible bodies in nature; and, by its great ponderosity, to be so much the more remote from such a liquor as water, that has not the sixteenth part of its specific weight; if this can be turn'd into an aqueous liquor, it will greatly favour our doctrine.

From quick-silver. Relating to a very ingenious and sober physician of my acquaintance, that in distilling mercury, without addition, I once obtain'd a water, but could not make the like experiment afterwards succeed; he assured me, that he, and a friend of his, having provided a very large *Dutch* retort of good earth, furnished with a pipe, and, by degrees, convey'd through that pipe a pound of quick-silver into the retort, made red-hot, they obtain'd four ounces of water, and lost two ounces of matter; the remaining part of the pound being elevated in the form of mercury: and the receiver, he said, was not applied, till the retort had been made thoroughly glowing hot; so that this liquor could not be the aqueous particles of the earth of the vessel. He added, that the liquor was very different from common water; because, pouring both their distill'd mercury, and their water, into a kind of *China* cup, they left them open, in a garret, for two or three days in *June*, upon a presumption, that this mercurial water, thus order'd, would turn a part of the quick-silver into its own nature, and so multiply it self upon it; but coming to their cup again, they were much surpriz'd to find the water all gone, and the greatest part thereof turn'd into mercury; which they

they concluded, because they miss'd, upon the balance, but about half an ounce of the whole matter, that was they supposed to have been lost by evaporation; the other three ounces and a half being found in the additional weight of the mercury. *Chymistry.*

And transmutable into other bodies.

And if *Helmont* says true, that by his liquor alkahest, not only quick-silver, but all other tangible bodies, may be reduced into insipid water, just like rain-water; I may infer, that water may be produced, since salt and sulphur themselves may be turn'd into it. I know the *Helmontians* might answer, that this is not so much a production, as a reduction, since all things consisting originally of water, the alkahest does but deprive it of the disguizes that seminal principles put it into, to make it appear under the form of gold, quick-silver, plants, animals, *&c.* But even by this answer 'tis granted, that water has actually been produced, in plenty, out of mineral bodies, tho' it has not yet been made appear, that those bodies were produced out of water. But supposing bodies, by the alkahest and the fire, were really reduced into water; *Helmont* farther relates, that by abstracting his immortal liquor from stones, or such kinds of bodies, he turned them into salt, equiponderant to the concrete; which salt, by further operations, he reduces, as he supposes, into elementary water. Since then he stops not at salt, but goes to a further transmuation; and concludes, that a stone doth not consist of salt, because that salt may be turn'd into insipid water; I say, that insipid water is not the first matter of bodies; since, by a farther operation of the fire, that liquor it self may be turn'd into earth. For clear water, several times very slowly distill'd out of clear glass bodies, has every time left me a terrestrial powder at the bottom; as if the whole body of the water might, by repeated distillations, without violence of the fire, be reduced into earth; whereof, in my last trial, I had enough to cover the bottom of a large cucurbit, out of which the distillations had been made.

And I shall here add an experiment, which seems to argue, that without the help of repeated distillations in tall cucurbits, clear water may, by the operation of the fire, be changed into another body.

We put very pure and limpid water, which had, by our pneumatic engine, been carefully freed from its aerial particles, into a new bolt-head, of such a size, that the matter might have room to play, and circulate; and sealing it up hermetically, we placed the vessel in a digestive furnace, and left it there above a year; and observed, that after it had continued for a considerable time, there began to form themselves in the water little concretions, heavier than it; which at length increased in magnitude, and, as we thought, in number; making a kind of *terra foliata*, that consisted of a multitude of little thin films, or scales, like those of the smaller sort of fish; which, when the glass was shaken in an enlightned place, were plentifully

Chymiſtry. diſpers'd thro' the body of the liquor, and appear'd variouſly and ſtrongly colour'd; ſome whereof were almoſt as big as ſpangles, but more glittering: and when the agitation ceaſed, they preſently fell to the bottom, and cover'd it. And the longer the glaſs was kept in the digeſtive furnace, the more of this fine terreſtrial ſubſtance was produced. But leſt the effect ſhould be aſcribed to the abſtraction of the air, I muſt add, that we produced the like ſubſtance, tho' not ſo plentifully, after the like manner, in water that had not at all been freed from air.

SECT. VI.

Earth a heterogeneous principle.

OF all the ſubſtances obtainable from mix'd bodies, that which to perſons, not prepoſſeſs'd with *Helmontian* opinions, may ſeem the moſt ſimple, elementary, and unchangeable, is, what they call earth, or *terra damnata*; becauſe it ſeems highly probable, that the calcining violence of the fire, muſt not only have driven away the mercurial, and other volatile parts, but have quite burnt out the ſulphurs, which are often more fixed than the reſt; as the water, on the other hand, is ſuppos'd to have diſſolv'd away all the fixed ſalt.

This reaſoning, I confeſs, is plauſible, but not ſatisfactory; for as the particulars wherein this ſuppoſed ſimplicity, and unchangeableneſs of the earthy part of mixed bodies is founded, are its not diſſolving in water, its not affecting the taſt, and its not having flown away from the incinerated body; it may, with probability, be doubted, whether any of theſe, or all of them put together, neceſſarily prove what the chymiſts pretend.

And producible. And, firſt, according to the different conſtitutions of certain bodies, we muſt diſtinguiſh between the dry and heavy parts that remain, after a body has been expos'd to the violence of the fire; and, if need be, freed from its ſalt as much as poſſible, by the affuſion of water. For 'tis evident, that in ſome bodies, eſpecially of a metalline nature, the calcining fire does not operate, as in the burning of vegetables; ſince ſometimes almoſt the whole weight of a mineral is to be found in what they call its calx; as is manifeſt in the calcination of tin and lead *per ſe*. And this calx is, in great part, reducible, ſometimes into a body of the ſame nature with that which afforded it, and ſometimes into another body, very far from being elementary, as appears in the reduction of minium; which, as to the greateſt part of it, we have more than once, by the bare manner of ordering the fire, reduced, in a very ſhort time, and without addition, into malleable lead; and alſo in the aſhes of antimony, which, by bare fuſion,

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Chymiſtry. only a compounded, but a re-compounded body, (becauſe the ſand, and other ſtones, being themſelves mixed bodies, are further compounded with the ſalts that diſſolve them) manifeſtly poſſeſſes all thoſe three qualities, which chymiſts require in their earth; for 'tis taſtleſs, indiſſoluble in water, and fix'd in the fire. And if aſhes of themſelves, be capable of vitrification, as chymiſts teach, and as the maſter of a glaſs-houſe told me he once found, with ſome difficulty; how are we ſure, that in common aſhes, freed, after the uſual way, from their fixed ſalt, what is called a ſimple earth, may not be a body compounded of two or more ſubſtances, which, by their coalition and new texture, produced by the action of the fire, have been brought to a kind of vitrification; or have otherwiſe acquired the obvious qualities that chymiſts think ſufficient to give a production of the fire the name of earth?

'Tis obvious, that ſeveral bodies, when of a ſenſible bulk, will ſink in liquors wherein their corpuſcles would freely ſwim, if many of them did not ſtick together. Thus lumps, and the grains of ſalt and ſugar, will fall to the bottom of water, in which, when they are diſpers'd into minute and inviſible particles, they will eaſily float. And I have obſerved in ſtopp'd glaſſes, that ſome ſalts, and other bodies, that, for many months, remained undiſtinguiſh'd in the liquors that harboured them, would, in tract of time, have conventions made of their particles, which then ſubſided; and be no more carried up and down by the particles of the liquor. And ſomewhat of this kind may, perhaps, happen to the particles whereof water conſiſts; for if ſome of theſe, by frequent occurſions and attritions, come to apply themſelves to one another, ſo as to have a fuller and more immediate contact than formerly; to be entangled among themſelves; and, perhaps, alſo, to exclude ſome very thin and ſubtile air, that lurks about them, and contributes to their ſuſtentation; the cluſters, tho' as to ſenſe but very ſmall, may prove too great and unweildy to be, any longer, parts of water, but may ſubſide in that liquor; and if their adheſion be ſtrong, they will, upon the ſame account, become unfit to riſe up in the form of vapours and exhalations, by heat, and ſo may be, like earth, fix'd in the fire, as well as indiſſoluble in water.

I have ſometimes, alſo, ſuſpected, that the production of an earthy ſubſtance in water, may be further'd by the particles of the fire, employed to make it circulate; and that of thoſe particles which pervade the glaſs, ſome of the leſs ſubtile may, in their paſſage, faſten themſelves to ſome aqueous particles, fitted to adhere to them; and with theſe begin to make ſome inviſible concretions, to which, afterwards, other congruous particles may gradually adhere in their paſſage; and ſo at length compoſe ſenſible aggregates of powder. Thus in the precipitation of quick-ſilver, without addition, the mercurial particles aſſociating themſelves with; and, probably, with ſome of thoſe of the

fire; begin to form concretions, at first very minute, which afterwards increase, by the accession of other adhering particles, till all the mercury, or the greatest part of it, be reduced, from a fluid body, to a red powder. And it may countenance this conjecture, as to the production of an earthy substance, by a brisk concurrence of the particles of fire, to add, that tho' I have kept highly rectified spirit of wine; for above a year together, hermetically seal'd up, and for the greatest part of that time, in a digestive furnace, without finding any earthy residence; yet, when I order'd a bolt-head, that, tho' it were hermetically seal'd, the alchohol of wine it contain'd, might be boil'd without breaking the glass; I found, in a short time, that this liquor would afford a considerable quantity of such a subsiding talky substance, as I obtain'd from the water formerly mention'd.

Two parts of tobacco-pipe clay, finely powder'd, and very well mix'd with one part of pulveriz'd crystals of nitre, being put into a crucible, and kept, for three hours, in a violent fire, the mixture was afterwards taken out, and the remaining fix'd salt, carefully extracted, but it amounted to a very little, in comparison of what nitre usually yields when calcined with charcoal; and, that this small proportion of fix'd salt did not, principally, proceed from any very large avolation of nitrous substance, appear'd probable, because the *Caput mortuum* was much more ponderous than could be expected upon account of the tobacco-pipe clay first employ'd, and the alkali extracted; so that the new weight, acquired by the clay, seem'd manifestly to proceed from the accession of a portion of the salt-petre, that, by this operation, was turn'd into earth; so that of six drams, which four ounces of clay had acquir'd in weight, after the crucible was taken out, not so many grains could, even by boiling water, be obtain'd from the whole *Caput mortuum*; which, when first separated from the crucible, was almost quite insipid.

That earth may, *de novo*, be produced, we may likewise argue from an experiment we made about the destruction of salt of tartar, by igniting and putting it into fair water; for there remain'd, after numerous filtrations, and after every single one, a substance in the filtre, which, for ought appears, may be as well call'd earth, as that which was separated from the calcined tartar, the first time it was put into the water, to divide the salt from the earth. For here, as well as in that common operation, the way of proceeding is the same; and in both, there remains in the filtre a substance, which, by its stay there, shows it to be indissoluble in water; and which, before it came thither, shew'd, by enduring a violent fire, that it was also fix'd, as earth ought to be. Nor would it much alter the case, if this factitious earth should have such an operation upon some particular body, as is thought not to belong to true elementary earth. For since it is obtain'd by a chymical analysis, if it have those qualities, that, in the general estimations, make up the notion of earth, that ought to suffice, at least, till the chymists

Chymistry. mists give us some more accurate definition of genuine earth, shew us such a thing, and teach us a better way to obtain it.

And in many bodies, that are reputed earth, I observe qualities which belong not to elementary earth, in the receiv'd notion thereof. This, I say, because I see not why such a texture, as will suffice to make a portion of matter indissoluble in water, fix'd in the fire, and insipid upon the tongue, may not also fit it to operate, actively, upon some bodies; and modify the operations of others that act upon it. And if our earth, obtain'd from salt of tartar, be, by the chymists, rejected as spurious, they must confess the insufficiency of their common way of separating a true earth from the bodies they analyze; for, it seems, calcination, solution in water, and filtration, which make up their usual method, will not suffice to make our earth of tartar pass for true; tho' it appear not to be near so remote from an elementary nature, as some other bodies that are obtain'd for earth by the vulgar analysis. I have found, that the *Caput mortuum* of vitriol, remaining after it had long endured a violent fire, tho' it were diligently freed from saltness, by repeated ablutions with hot water, was yet far from being an elementary earth; as appear'd by its deep purplish colour; its weight, far exceeding that of earth; and by an experiment that I purposely made to examine it.

And an acquaintance of mine, who dealt much in *Hungarian* vitriol, affirm'd to me, that he had out of the colcothar of a certain sort of vitriol, not only received a considerable quantity of good copper; but separated from that copper a large portion of silver, and some grains of true gold.

No natural elementary earth.

I have not yet seen it prov'd, that nature, any more than art, affords us a true elementary earth; at least, I can say, that some, which seem to be of the more simple sort, I found, upon examination, had qualities not ascrib'd to pure earth. For, tho' tobacco-pipe clay, by reason of its fixity, whiteness, and insipidity, and its lying often deep beneath the surface of the ground, may as probably as almost any other native earth, seem elementary; yet tobacco-pipes, well-bak'd, may, sometimes, be made to strike fire: and I have, more than once, try'd, that by briskly rubbing two pieces of a new tobacco-pipe one against another, they would, in a minute or two, grow warm; and being immediately smelt to, manifestly afforded a rank scent, between sulphureous and bituminous, almost like that which proceeds from pebbles and flints, when they are, likewise, rubb'd hard against one another: as if tobacco-pipe clay were not a true earth, but a fine white sand, consisting of grains too small to be distinctly taken notice of, like those of other sand. And I found, by a hydrostatical trial, that its specific gravity was but little different from that of pebbles; its proportion in weight to water of the same bulk, being as two and a quarter to one. A tobacco-pipe may be, also, somewhat melted by a very vehement fire; for it will thereby be brought to bend.

Porcel-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

THE IMPERFECTION OF THE CHYMICAL DOCTRINE OF QUALITIES.

SECT. I.

The chymical theory of qualities narrow, defective, and uncertain.

THE foundation of all the vulgar chymical theory ſeems to me precarious, and has never been demonſtrated. 'Tis ſtrange, that neither the chymiſts themſelves, nor their adverſaries, ſhould have taken notice, that the analyſis by fire, is not the only inſtrument of diſcovering the ingredients of mix'd bodies; ſince in ſeveral caſes, this may be found by compoſition, as well as by reſolution. Thus vitriol appears to conſiſt of metalline parts, aſſociated by coagulation, with acid ones, as well by making true vitriol with ſpirit of ſulphur, or that of ſalt, as by reſolving it by the fire.

And whatever chymiſts may be able to obtain from particular ſubſtances, it does not appear by experience, which is the grand argument they rely on, that all mixt bodies, endowed with qualities, conſiſt of their *tria prima*; ſince they have not been able, truly, and without new compoſitions, to reſolve into thoſe three, gold, ſilver, cryſtal, *Venetian* talc, *&c.* yet theſe bodies have ſeveral qualities; as the two former are fuſible and malleable; and all of them have weight and fixedneſs: ſo that in theſe and the like bodies, whence chymiſts have not yet made it appear, that their ſalt, ſulphur, and mercury can be truly and adequately ſeparated, 'twill ſcarce be other than pre-

precarious, to derive the malleableneſs, colour, and other qualities of ſuch bodies from thoſe principles. *Chymiſtry.*

A great part of the chymical doctrine of qualities, is, alſo founded on, or ſuppoſes ſome other things, which, as far as I know, have not yet been well proved; and I queſtion whether they ever will be. *Suppoſes things not proved.*

One of their grand ſuppoſitions is, that each particular quality muſt have its πρῶτον δεκτικὸν, or ſome peculiar material principle, to the participation of which, as of the primary, native, and genuine ſubject, all other bodies muſt owe it: but 'twill be hard to ſhew, what is the πρῶτον δεκτικὸν of gravity, volatility, heat, ſound, tranſparency, and opacity; which are qualities to be indifferently met with in bodies, whether ſimple or mixt.

The chymiſts, too, are apt to argue, that, becauſe this or that quality, is not to be truly derived from this or that particular principle; as ſalt, for inſtance, and mercury; therefore it muſt needs be derivable from the third, as ſulphur. But this way of arguing implies, that every quality in a compound body, muſt ariſe from ſome one of the *tria prima*; tho' experience ſhews us, that bodies may, by compoſition, obtain qualities, that were not to be found in any of the ſeparate ingredients. Thus in painting, though blue and yellow be neither of them green, yet their mixture will be green. And tho' no ſingle ſound will make an octave, or *diapaſon*; yet two ſounds, whoſe proportion is double, have an eighth. Tin and copper melted and mixed together in a due proportion, make bell-metal, which is far more ſonorous than either of them apart. And 'tis obvious for chymiſts to obſerve, that, tho' lead be an inſipid body, and ſpirit of vinegar a very ſharp one, yet *Saccharum Saturni*, a compound of theſe two, is ſweet.

But this ill-grounded ſuppoſition of the chymiſts, is extended farther in an uſual topic of theirs, according to which they conclude, that many qualities, as well manifeſt as occult, muſt be explained by their *tria prima*, becauſe they are not explicable by the four elements of the *Peripatetics*. But to make this argument valid, it muſt be proved, that there are no other ways by which thoſe qualities may be explained, but by a determinate number of material principles.

But there are ſeveral qualities, even in mixt bodies, wherein the chymical doctrine is unneceſſary. For inſtance, when pure gold is, by bare heat, brought to the ſtate of fluidity; and, upon the remiſſion of that heat, grows a ſolid and conſiſtent body again; what addition, expulſion, or alteration of any of the *tria prima*, cauſes this change of conſiſtence? Tho' this is eaſily accounted for in the mechanical way, by the vehement agitation that the fire makes of the minute parts of the gold, to bring it to fuſion; and the coheſion of thoſe parts, by virtue of their gravity and fitneſs to adhere to one another, when that agitation ceaſes. When *Venice* glaſs is merely, by being beaten to powder, deprived of its tranſparency, and turned into a white, opake body, what need have we of the *tria prima* to ſolve this phenomenon? *Is often ſuperfluous.*

Chymiſtry.

But further; the chymical doctrine of qualities is inſufficient, and too narrow to reach to all the phenomena that ought to be explicable by it. For there are many qualities, which chymiſts will not attempt to explain; and the ſolutions they give of other particular qualities, are often very deficient and unſatisfactory. Thus, tho' gold be the body they moſt affect to converſe with; yet it will be very hard to ſhew, how its ſpecific weight can be deduced from the three principles, ſince mercury it ſelf is much lighter than gold; and the two other hypoſtatical principles are far lighter than mercury. And, I think, it would much puzzle the chymiſts, to give us an example of a compound body, ſpecifically heavier than the heavieſt of its ingredients.

Again; there are ſeveral bodies, which, tho' the moſt learned chymiſts confeſs, do not conſiſt of their *tria prima*, yet are endowed with qualities, that conſequently are not in thoſe ſubjects to be explained by the *tria prima*. Thus elementary water, tho' never ſo pure, has fluidity, coldneſs, humidity, tranſparency, and volatility, without any of the *tria prima*. And the pureſt earth, as aſhes carefully freed from the fixed ſalt, has gravity, conſiſtence, dryneſs, colour, and fixedneſs, without owing them either to ſalt, ſulphur, or mercury. Since, then, in earth, water, *&c.* ſuch diffuſed qualities, as gravity, fixedneſs, colour, *&c.* muſt be acknowledged not to proceed from the *tria prima*; 'tis plain, that portions of matter may be endowed with ſuch qualities, by other cauſes and agents than ſalt, ſulphur, and mercury; why, therefore, ſhould we deny, that alſo in compound bodies, thoſe qualities may be produced by the ſame, or the like cauſes? Thus the reduction of a tranſparent ſolid to powder, produces whiteneſs, whether the comminution happens to rock-cryſtal, *Venice* glaſs, or to ice: the firſt of which is acknowledged to be a natural, and perfectly mix'd body; the ſecond, a factitious and re-compounded body; and the laſt, for ought appears, an elementary body, or at moſt, a body very ſlightly and imperfectly mixt. And ſo by uniting air in ſmall portions, with a tranſparent liquor, as when we beat ſuch a liquor into foam, a whiteneſs is produced, as well in pure water, which is acknowledged to be a ſimple body, as in white-wine, which is reckoned among bodies perfectly mixt.

And further; the chymical explanations are not ſufficiently extenſive; for moſt of them are not ſo diſtinct and full, as to reach the particular phenomena, nor often ſo much as to all the grand ones, that belong to the hiſtory of the qualities they pretend to account for. A chymiſt will not eaſily ſhew by his ſalt, ſulphur, and mercury, why a load-ſtone, capp'd with ſteel, may be made to take up much more iron, than if it be immediately applied to the iron; or why, if one end of the magnetic needle is diſpos'd to be attracted by the north pole, for inſtance, of the load-ſtone, the other pole of the load-ſtone will drive it away: or, why a rod of iron, being heated red hot, and cooled perpendicularly, will, with its lower end, drive away the flower-de-luce,

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Chymistry.

And when they tell us, that the fusibility of bodies proceeds from sulphur, in case they say true, they only tell us what material ingredient 'tis, that being dispers'd through the other parts of a body, makes it apt to melt: but this does not intelligibly shew what it is that makes a portion of matter fusible; and how the sulphureous ingredient introduces that disposition into the rest of the mass wherewith 'tis united: yet they are such explanations as these, that a philosopher chiefly looks after. And to shew, that there may be more fundamental explanations, I shall only observe, that sulphur it self is fusible; and therefore, as I lately intimated, fusibility, which is not the quality of a single atome, or particle, but of an aggregate of particles, ought it self to be accounted for in that principle, before the fusibility of all other bodies be derived from it. And in sulphur it self, that quality may be probably deduced from the convention of corpuscles of determinate shapes and sizes, connected after a particular manner. And if nature, art, or chance, should bring together particles endowed with the like mechanical properties, and associate them after the like manner, the resulting body would be fusible, though the component particles had never been parts of the chymists primordial sulphur, and such particles so convening, might perhaps have made sulphur, though before there had been no such body in the world. And though I readily allow, that sulphur, or another of the *tria prima*, may abound in several bodies endowed with the quality that is attributed to their participation of that principle; yet this is no certain sign, that the propos'd quality must flow from that ingredient. Thus, if tin, for example, be duly mix'd with copper or gold, silver or iron, it will make them very brittle; and it is also an ingredient of several other bodies that are likewise brittle; as colour'd amels, which are usually made of calcin'd tin, (call'd by tradesmen putty,) melted with the ingredients of crystal-glass, and some small portion of a mineral pigment. But though in all these brittle bodies, tin be a considerable ingredient; yet 'twere very rash to affirm, that brittleness, in general, proceeds from tin: for provided the solid parts of consistent bodies touch one another but in small portions of their surfaces, and be not entangled by their contexture, the metalline or other composition may be brittle, tho' there be no tin at all in it: and, in effect, the materials of glass being brought to fusion, will compose a brittle body, as well when there is no putty colliquated with them, as when there is. Calcin'd lead, by the action of the fire, may be melted into a brittle mass, and even into transparent glass, without the help of tin, or any thing else. And there are numerous other bodies, that cannot be pretended to owe their brittleness to any participation of tin, of which they have no need, if the matter they consist of, wants not the requisite mechanical dispositions.

And the way employed by chymists, and *Peripatetics*, of accounting for things from the materials, whether elements, principles, or other ingredi-

ingredients, of bodies, will often fruſtrate this expectation; for a new quality, differing from, or contrary to, any that is conſpicuous in the ingredients, will frequently ariſe upon their mixture; as two tranſparent bodies may make an opake one; a yellow body and a blue, one that is green; two malleable bodies, a brittle one; two actually cold bodies, a hot one; two fluid bodies, a conſiſtent one, *&c.* And as this way of judging, by material principles, hinders the fore-knowledge of events from being certain, it much more hinders the aſſignation of cauſes from being ſatisfactory; ſo that thoſe who judge of all mix'd bodies, as apothecaries do of medicines, barely by the qualities and proportions of the ingredients, ſeem to act as one who ſhould pretend to give an account of the phenomena and operations of clocks and watches, from the predominancy of the metals that make their parts, and not from their ſtructure and contrivance. *Chymiſtry.*

And frequently contradicts the phenomena of nature.

The next defect I obſerve in the chymical doctrine of qualities, is, that in many caſes it agrees not with the phenomena of nature. For there are ſeveral changes of qualities, wherein one may well expect, that a chymical principle ſhould have a great ſhare, and yet it does not appear to have any. He who conſiders what great operations many chymiſts aſcribe to this or that hypoſtatical principle, and how many qualities, according to them, muſt from thence be derived, cannot but expect, that a great change, as to thoſe qualities, happening in a mix'd body, ſhould, at leaſt, be accompany'd with ſome notable action of, or alteration in the principle; yet I have met with many inſtances, wherein qualities are produced, or aboliſhed, or very much altered, without any manifeſt introduction, expulſion, or conſiderable change of the principle, whereon that quality is ſaid to depend. Thus, for inſtance, a piece of fine ſilver, having been neal'd in the fire, and ſuffer'd to cool leiſurely, is very flexible; but may be made ſtiff and hard, barely by a few ſtrokes of a hammer. There is, alſo, another ſort of phenomena, which oppoſes the chymical doctrine about qualities, conſiſting of thoſe, wherein either that does not happen, which, according to their hypotheſis, ought to happen, or the contrary to what, upon their principles, might juſtly be expected. For inſtance, 'tis known to thoſe who work much in ſilver and copper, that the former will become red-hot in the fire, before it is brought to fuſion; and that the latter is yet far more difficult to be melted down than the other; yet if you ſeparately diſſolve thoſe two metals in *Aqua fortis*, and by evaporation, reduce them to cryſtals; theſe will be brought to fuſe in a very little time, and with a moderate heat in glaſſes. Aſk a vulgar chymiſt, the cauſe of this facility of fuſion, and he will probably tell you, that 'tis from the ſaline parts of the *Aqua fortis*, which, imbodied in the metals, and being of a very fuſible nature, impart that eaſineſs of fuſion thereto. Now from this plauſible explanation one might well expect, that if the ſaline corpuſcles were exquiſitely mixed with tin, they would make it far more fuſible than of it ſelf it is; yet, when I put tin into a con-

Chymistry. convenient quantity of *Aqua fortis*, the metal being corroded, subsided, as is usual, in the form of whites of eggs, which being well dried, the tin was so far from growing more fusible, that it would long endure not only a thorow ignition, but the blast of a pair of double bellows, without being at all brought to melt. And as for those chymists who admit, that all kinds of metals may be turned into gold, by a very small proportion of the elixir; they must allow from their own concessions, that several qualities may be changed, even in metals, without the addition of any considerable proportion of the simple ingredients, to which they ascribe those qualities; provided the agent be able to make a great change in the mechanical properties of the parts whereof the metal it acts upon consists. Thus if we suppose a pound of silver, a pound of lead, and a pound of iron, to be transmuted into gold, each by a grain of the powder of projection; this powder, as a material cause, is inconsiderable, by the smallness of its bulk; and as an efficient, it works differing, and even contrary effects, according to the disposition wherein it finds the metal to be transmuted, and the changes it produces in the constituent texture thereof. Thus it brings quicksilver to be fixt, and deprives it of the fluidity it had before; it brings silver to be insoluble in *Aqua fortis*, which readily dissolved it before, and soluble in *Aqua regis*, which before would not touch it; and, what is very considerable to our present purpose, whereas it makes iron much more fusible, it makes lead much less fusible than whilst it retained its pristine form; since lead melts before it comes to ignition, which gold requires to bring it to fusion.

But some modern chymists would be thought to explain several of the changes that happen to bodies in point of odour, colour, *&c.* by saying, that in such alterations the sulphur, or other hypostatical principle, is intraverted or extraverted; which, I confess, seem to me rather new terms, than real explanations. For it may be justly objected, that the supposed extraversion or intraversion of sulphur can, by no means, give an account of so great a variety of odours, colours, and other qualities, as may be found in the changed portions of matter we are speaking of. Besides, what they call by these and the like names, cannot be done without local motion, transposing the particles of the matter, and, consequently, producing in it a change of texture, which is the very thing we would infer; and which being supposed, we may grant sulphur to be often actually present in the altered bodies, without allowing it to be always necessary to produce the alterations in them; since corpuscles, so condition'd and arranged, would produce such effects, whether sulphur did, or did not, make the subject-matter of the change.

The principles found in bodies not the cause of their qualities.

I shall mention but two imperfections more that particularly relate to the doctrine of qualities.

And first, I do not think it a convincing argument, that is employed by the *Aristotelians* for their elements, and by the chymists for their

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

The Chymical Doctrine

SECT. II.

Reflections upon the hypotheſis of alkali and acid.

I Preſume, it will not be difficult to diſcern, that a great part of what has been alledg'd to ſhew the imperfection of the vulgar chymical doctrine of qualities, may eaſily be applied to ſome other hypotheſes of kin to that doctrine, and particularly to the theory that would derive both the qualities of bodies, and the reſt of the phenomena of nature, from acid and alkali. For tho' theſe two differences may be met with in a great variety of bodies, and conſequently the conſideration of them will frequently be of good uſe to chymiſts, in conſidering the ſecondary cauſes and operations of ſome mixt bodies; yet I cannot allow of the hypotheſis in the latitude wherein 'tis urged and applied, as if it could be uſefully ſubſtituted in the place of matter and motion.*

The ſuppoſition of them precarious.

For it ſeems precarious to affirm, that acid and alkaline parts are found in all bodies.

Some chymiſts, when they ſee *Aqua fortis* diſſolve filings of copper, conclude from thence, that the acid ſpirits of the menſtruum meet, in the metal, with an alkali, upon which they work; † but this is an un-

* "Since, "ſays M. *Homberg*, "the "doctrine of alkali and acid has been ad- "vanced, 'tis made uſe of to explain all "the changes that happen in the mixtures "of ſimples, particularly in the effects of "fermentation, efferveſcence, and ebulli- "tion. But there is ſcarce any fermen- "tation produced by the mixture of acid "and alkali; and even ebullitions and "efferveſcences often proceed from other "cauſes." See *French Memoirs, A.* 1701. *p.* 146.

† M. *Homberg* is of opinion, that all acid ſpirits diſſolve bodies, by means of the ſalt which ſuch ſpirits contain; and to diſcover their quantity of pure acid ſalts, he ſuffers an ounce of ſalt of tartar to ſaturate it ſelf with the ſpirit; then evaporating all the moiſture, the ſalt of tartar remains increaſed by the weight of the acid ſalts.

By this means he made the following table.

		oz.	*dr.*	*gr.*		*dr.*	*gr.*		*dr.*	*gr.*
An ounce of ſalt of tartar took up of	Spirit of nitre	01	02	36	And gained after evaporation	03	10	Whence an ounce of the liquor contain'd of volatile acid ſalt	02	28
	—of ſalt	02	05	00		03	14		01	15
	Oil of vitriol	00	05	00		03	05		04	65
	Aqua fortis	01	02	30		03	06		02	26
	Diſtill'd vinegar	14	00	00		03	36		00	18

Fig. 5.

He, likewiſe, uſes an inſtrument, or aræometer, made of a ſmall glaſs matras, with a neck, AD, ſo ſlender, that a ſingle drop of water will riſe about half an inch in it. On the ſide of this neck there comes from the belly B, of the veſſel, a ſmall tube C, of the ſame ſize with the neck, and parallel to it, above half an inch long. This little tube lets the air paſs out of the veſſel, as the liquor comes in. A mark, D, is put upon the neck AD, to ſhew how high the veſſel muſt be filled. And 'tis proper to let the neck widen towards the top, for the conveniency of pouring in the liquor

unſafe way of arguing, ſince good ſpirit of urine, which they take to be a volatile alkali, and which makes a great conflict with *Aqua fortis*, will readily diſſolve filings of copper, and more genuinely than the acid liquor. So when they ſee the magiſtery of pearl or coral, prepared by dropping oil of tartar into the ſolutions of thoſe bodies, made with ſpirit of vinegar, they aſcribe the precipitation to the fixt alkali of the tartar, that mortifies the acidity of the ſpirit of vinegar; whereas the precipitation would no leſs enſue, if, inſtead of the alkalizate oil of tartar, that ſtrong acid, *Oleum ſulphuris per campanam*, were employ'd.

liquor. Now this inſtrument being fill'd to the mark on its neck, with any acid ſpitit, the balance will ſhew the weight of the liquor, in reſpect of any other, to the fifth part of a drop. Hence this ingenious gentleman has made a table, to ſhew the different weights of the ſame bulk of the moſt conſiderable chymical liquors, in the ſummer and in winter.

The Araeometer full of	Weigh'd in ſummer. oz.	dr.	gr.	In winter. oz.	dr.	gr.
Quick-ſilver	11	00	07	11	00	32
Oil of tartar	01	03	08	01	03	31
Spirit of urine	01	00	32	01	00	43
Oil of vitriol	01	03	58	01	04	03
Spirit of nitre	01	01	40	01	01	70
—— of ſalt	01	00	39	01	00	47
Aqua fortis	01	01	38	01	01	55
Diſtill'd vinegar	00	07	55	00	07	60
Spirit of wine	00	06	47	00	06	61
River-water	00	07	53	00	07	57
Diſtill'd water	00	07	50	00	07	54

The inſtrument it ſelf weighed, when empty, one dram twenty-eight grains.

From theſe two tables, compared together, 'tis eaſy to determine, with great exactneſs, the quantity of ſalt and of phlegm contain'd in an acid ſpirit. See *Memoirs de l' Acad. A.* 1669. *p.* 69.

To meaſure the force of an alkali, that is, to eſtimate how much of an acid 'tis able to retain, the ſame gentleman proceeds in this manner. He diſſolves the alkali in ſome acid ſpirit, whoſe force is firſt diſcovered by means of his araeometer; comparing its weight with that of river-water. Thus having dephlegmed ſome ſpirit of nitre, and of ſalt, till the former perfectly diſſolved gold, and the latter, ſilver, he found the weight of the ſpirit of nitre to be, in an equal bulk, as 19, that of the ſpirit of ſalt as 17, and that of water as 16. He put an ounce of each ſpirit, upon crabs-eyes, coral, pearl, bezoar, oyſter-ſhells, *&c.* of which they diſſolved different quantities; the ſpirit of nitre taking up twice as much of ſome of them as the ſpirit of ſalt; and, in general, the former diſſolved a conſiderable quantity more than the latter; the proportion of its ſalt being almoſt double to that of the other. Now the different quantity of each alkali neceſſary to abſorb the ſame quantity of a ſtandard acid, is, according to M. *Homberg*, the meaſure of the paſſive force of that alkali; notice being taken of the time ſpent in the diſſolution. This author farther obſerved, that both the ſpirits readily diſſolved much more of the oyſter-ſhells than of any other powder of the like nature; which he takes to be one reaſon of the very good effect they have in the ſtomach, depraved by acids. *Memoir de l' Acad. A.* 1700. *p.* 81. and *Hiſt. de l' Acad. A.* 1700. *p.* 63.

Chymiſtry.

It alſo may be doubted, whether the vulgar chymiſts juſtly ſuppoſe, that when they manifeſtly diſcover an acid, for inſtance, in a body, the operation of that body upon another, which they judge to abound with an alkali, muſt be the effect of a conflict between thoſe two principles. For an acid body may do many things, not ſimply as an acid, but on account of a texture or modification, which endows it with other qualities as well as acidity. Thus when ſome chymiſts ſee an acid menſtruum, as *Aqua fortis*, ſpirit of ſalt, oil of vitriol, *&c.* diſſolve iron, they preſently aſcribe the effect to an acidity in the liquors; tho' well dephlegmed urinous ſpirits, which they hold to have a great antipathy to acids, will, as I have tried in ſome of them, readily diſſolve crude iron, even in the cold. But mercury will not work on the filings of iron, tho' this be ſo open a metal, that even weak liquors will do it; yet if one ſhould urge, that quick-ſilver readily diſſolves gold in amalgamation, he may expect to be told, according to their doctrine, that mercury has in it an occult acid, by which it performs the ſolution; tho' it ſeems much more probable, that mercury has corpuſcles of ſuch a ſhape and ſize as fit them to inſinuate into the correſpondent pores they meet with in gold, but render them unfit to enter readily the pores of iron, to which nature has not made them ſuitable: as on the other ſide, the ſaline corpuſcles of *Aqua fortis* will eaſily find admiſſion into the pores of iron, but not into thoſe of gold, to which they do not correſpond. And when a knife, whoſe blade is touched with a load-ſtone, cuts bread, and takes up filings of iron, it does neither by means of alkali or acid; but the one by the viſible ſhape and the ſtiffneſs of the blade, and the other by the latent contrivance or change of texture, produced by the operation of the load-ſtone in the particles of the ſteel.

And thus too, when blue vitriol, being beaten and finely ſearced, makes a white powder, that whiteneſs is not a quality of the powder, as being of a vitriolate nature; for rock-cryſtal, or *Venice* glaſs, finely beaten, will have the ſame effect on the eye; but it proceeds from the tranſparency of the body, and the minuteneſs, multitude and confus'd ſituation of the corpuſcles that make up the powder. And, therefore, if other bodies be brought, by comminution, into parts of the like mechanical properties; theſe aggregates will act upon the organ of ſight as white bodies.

Their offices arbitrary.

Further, the patrons of this hypotheſis ſeem arbitrarily to have aſſigned offices to each of their two principles, as the chymiſts do to each of their *tria prima*, and the *Peripatetics* to each of their four elements. But 'tis not enough to ſay, that an acid, for inſtance, performs theſe things, and an alkali thoſe; and that they divide the operations and phenomena of natural bodies between them: aſſertions of ſuch great moment ought not to be advanced, or received, without ſufficient proof. And, perhaps, the very diſtribution of ſalts into acids and alkalies hath ſomewhat of arbitrary in it; ſince others may, with-

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Chymistry. diſſolves another, which is diſſoluble by this or that known acid, the ſolvent muſt alſo be acid; or to conclude, that if a body precipitates a diſſolved metal out of a confeſſedly acid menſtruum, the precipitant muſt be an alkali, is precarious; ſince filings of ſpelter will be diſſolved as well by ſome alkalies, *viz.* ſpirit of ſal-armoniac, *&c.* as by acids: and bodies may be precipitated out of acid menſtrua, by other acids, and by liquors wherein there appears not the leaſt alkali. I have found, that a ſolution of tin-glaſs, made in *Aqua fortis*, would be precipitated both by ſpirit of ſalt, and by common or rain-water. And as for the other grand way that chymiſts employ, to diſtinguiſh acids and alkalies, by the heat, commotion, and bubbles that are excited, upon their being put together; this may be no ſuch certain ſign as they preſume: for almoſt any thing that is fitted variouſly and vehemently to agitate the minute parts of a body, will produce heat in it; and ſo, tho' water be neither an acid nor an alkalizate liquor, yet it will quickly grow very hot, not only with the highly acid oil of vitriol, but with the alkalizate ſalt of tartar: yet in neither of theſe mixtures is there produced any ſuch viſible or audible conflict, as, according to the doctrine of the chymiſts, one would expect. Neither is the production of bubbles, tho' accompanied with a hiſſing noiſe, ſuch a certain ſign as chymiſts imagine: for the production of bubbles is not a neceſſary effect or concomitant of heat, excited by conflict; but depends very much upon the peculiar diſpoſition of bodies, put together, to extricate, produce, or intercept particles of air; and therefore, as oil of vitriol, mixt in a due proportion with fair water, may be brought to make the water very hot, without exciting bubbles; ſo I have found that alkalizate ſpirit of urine, drawn with ſome kinds of quick-lime, being mixt with oil of vitriol moderately ſtrong, would afford an intenſe heat, whilſt it produced either no manifeſt bubbles at all, or ſcarce any; tho' the urinous ſpirit was ſtrong, and in other trials operated like an alkali; and tho' with ſpirit of urine, made *per ſe*, in the common way, oil of vitriol will produce a great hiſſing, and a multitude of conſpicuous bubbles. On the other ſide, I have, ſometimes, found, that ſome acid ſpirits, eſpecially that of verdigreaſe, made *per ſe*, would, when poured upon ſalt of tartar, make a conflict with it, and produce a large froth; tho' we obſerved it not to be accompanied with any manifeſt heat.

The taſt no judge of alkalies and acids. The taſt, by many, is made the touch-ſtone whereby to try acids and alkalies. But there is a multitude of mixt bodies, wherein we can ſo little diſcern by the taſt, which of the principles is predominant, that this would not make one ſuſpect there were a grain of either of them to be found therein; ſuch bodies are diamonds, rubies, and moſt gems, beſides many ignobler ſtones, gold, ſilver, mercury, *&c.* There are alſo bodies that abound with acid or alkalizate ſalts, which either have no taſt, or a quite different one from that of the chy-

chymical principles. Thus, tho' *Venice* glaſs be in a great part compoſed of a fixt alkali; yet it is inſipid upon the palat: and cryſtals of ſilver, and of lead, made with *Aqua fortis*, and containing numerous acid particles of the menſtruum, manifeſt nothing of acidity in the mouth; the latter having a ſaccharine ſweetneſs, and the former an extream bitterneſs. And even in vegetable ſubſtances of a manifeſt taſt, 'tis not eaſy to know by that, whether it be the acid or the alkalizate principle which rules in them; as in the eſſential oils of ſpices and other vegetables, and in the groſs empyreumatical oils of woods, and even in high rectified ſpirit of wine, which, therefore, ſome will have to be an alkalizate liquor, and others an acid, tho' I did not find its taſt to be deſtroyed or much altered by being put upon coral or ſalt of tartar, nor by being digeſted with and diſtill'd from ſea-ſalt. And among thoſe very bodies which, for their taſts, chymiſts reckon among acids, there is ſo great a difference and variety of reliſhes, that, if I were to allow acids to be one principle, it ſhould be as I allow air to be one body, whilſt it conſiſts of the aſſociated effluvia of a multitude of corpuſcles of very differing natures.*

Ano-

* At once to eſtabliſh a juſt notion, to explain the nature, the manner of action, and the force of acids, take the words of the illuſtrious Sir *Iſaac Newton* upon the ſubject.

" The particles of acids, " ſays that great philoſopher, " are of a ſize groſſer " than thoſe of water, and therefore leſs " volatile; but much ſmaller than thoſe " of earth, and therefore much leſs fix'd " than they. They are endued with a " great attractive force; in which force " their activity conſiſts; and thereby alſo " they affect and ſtimulate the organ of " taſt, and diſſolve ſuch bodies as they " come at. They are of a middle nature, " between water and terreſtrial bodies, and " attract the particles of both. By this at- " tractive force they get about the particles " of bodies, whether they be of a metal- " line or ſtony nature, and adhere to them " moſt cloſely on all ſides; ſo that they " can ſcarce be ſeparated from them by " diſtillation, or ſublimation. When they " are attracted and gathered together about " the particles of bodies, they raiſe, diſ- " join, and ſhake them one from another; " that is, they diſſolve thoſe bodies. By " their attractive force, alſo, by which " they ruſh towards the particles of bodies, " they move the fluid, excite heat, and " ſhake aſunder ſome particles, ſo as to " turn them into air, and generate bubbles; " and hence proceeds diſſolution, and all " violent fermentation: and in all fermen- " tation there is an acid latent or ſuppreſs'd, " which coagulates in precipitation. Acids, " alſo, by attracting water, as much as " they do the particles of bodies, occaſion " the diſſolved particles readily to mix " with water, or ſwim, or float in it, after " the manner of ſalts. And as this globe of " earth, by the force of gravity, attracting " water more ſtrongly than lighter bodies, " cauſes thoſe lighter bodies to aſcend in " the water, and to go upwards from the " earth; ſo the particles of ſalts, by at- " tracting the water, mutually avoid and " recede from one another as far as they " can, and thence are diffus'd throughout " the whole water. The particles of *Sal* " *alkali* conſiſt of earth and acid united to- " gether, after the ſame manner: but theſe " acids have ſo great an attractive force, " that they can't be ſeparated from the " ſalts by fire. They alſo precipitate the " particles of metals diſſolv'd in menſtrua, " by attracting from them the acid particles, " which before had diſſolved them, and " kept them ſuſpended in the menſtruum. " If theſe acid particles be join'd with " earthy

Chymiſtry. Another particular wherewith I am unſatisfied in the hypotheſis of acid and alkali, is, that 'tis in many caſes needleſs to explain the

" earthy ones, in a ſmall quantity, they " are ſo cloſely retained by them, as to be " quite ſuppreſs'd, and, as it were, hidden " by them; ſo that they neither ſtimulate " the organ of ſenſe, nor attract water, but " compoſe bodies which are not acid, that " is, fat and fuſible bodies, ſuch as are " *Mercurius dulcis*, brimſtone, *Luna cornea*, " and copper corroded by mercury ſubli- " mate. From the attractive force in theſe " acid particles thus ſuppreſs'd, ariſes that " univerſal property of almoſt all fat bo- " dies, that they adhere or ſtick to others, " and are eaſily inflammable, if the heated " acid particles meet with other particles " of bodies in fume, which the acid at- " tracts more ſtrongly, than it doth the " particles to which it is united. And thus " the acid that lies ſuppreſs'd in ſulphu- " reous bodies, by more ſtrongly attracting " the particles of other bodies (earthy ones " for inſtance) than its own, promotes a " gentle fermentation, produces and che- " riſhes natural heat, and carries it on " ſometimes, as the putrefaction of the " compound: Which putrefaction ariſes " hence, that the acid particles, which have " a long while kept up the fermentation, at " length inſinuate themſelves into the little " interſtices, that lie between the particles " of the firſt compoſition; and ſo, inti- " mately uniting with thoſe very particles, " produce a new mixture or compound, " which cannot fall back again into the " ſame form.

" Nitre in diſtillation, leaving its earthy " part behind, turns, moſt of it, into an " acid ſpirit; becauſe the acid of the nitre " attracts the phlegm, and, therefore, they " aſcend together, and conſtitute a ſpirit. " But nitre kindled with a coal, turns " chiefly into a ſalt of tartar; becauſe the " fire apply'd this way, drives the acid and " earthy parts together, and makes them " impinge on, and more ſtrongly unite one " with another. The reaſon why water " hath no great diſſolving force, is, be- " cauſe there is but a ſmall quantity of acid " in it: for whatever ſtrongly attracts, and " is ſtrongly attracted, may be called an " acid; and in ſuch things as are diſſolv'd " in water, we ſee the diſſolution is eaſily " perform'd, and without any efferveſcence: " but where the attraction is ſtrong, and " the particles of the menſtruum are every " way attracted by thoſe of the metal; or " rather, where the particles of the metal " are every way attracted by thoſe of the " menſtruum; there the particles of the " menſtruum environ thoſe of the metal, " tear them aſunder, and diſſolve its tex- " ture. So when theſe acid particles are " applied to the tongue, or to any exco- " riated part of the body; leaving the ſub- " tile earth in which they were before, they " ruſh into the liquid of the organ, tear " and disjoin its parts, and cauſe a painful " ſenſation.

" Mercury is attracted, and, therefore, " corroded by acids; and as it opens ob- " ſtructions by its great weight, ſo it breaks " and obtunds the power of acids, in the " body, by its attractive force."

" All bodies have particles which mutu- " ally attract one another; the aggregates " of the leaſt of which may be called par- " ticles of the firſt compoſition; and the " collections, or aggregates, ariſing from " the primary aggregates, or the aggregates " of theſe aggregates may be called par- " ticles of the ſecond compoſition, *&c.*

" Mercury and *Aqua regia*, pervade thoſe " pores of gold or tin, which lie between " the particles of its laſt compoſition; but " they can get no further into it; for if " any menſtruum could do that, or if the " particles of the firſt, or, perhaps, of the " ſecond compoſition of gold, could be ſe- " parated, that metal might be made fluid, " or at leaſt more ſoft. And if gold could " be once brought to ferment and putrefie, " it might be turned into any other body " whatſoever; and ſo of tin, or any other " bodies; as common nouriſhment is turn- " ed into the bodies of animals and vege- " tables." *Newton. apud Harris. Lexicon Technic.*

phe-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Chymistry. Again; the explanations given of phenomena, according to the doctrine of alkali and acid, do not perform what may be justly expected from philosophical solutions. 'Tis said, indeed, that the acid working on the alkali, or this upon that, produces the effect proposed; but this is only to tell us, what is the agent that operates, and not the manner of the operation, or the means and process whereby it produces the effect. And if it be said, that it is by the mutual hostility of the principles, that the effect is produced, it may be answered, that this hostility it self is not, as we have just now observed, a thing clear, if so much as intelligible; and were it, yet so general and indeterminate a way of explaining things, can afford little or no satisfaction to one who considers how very numerous and various the phenomena of qualities are.

To clear and confirm this assertion, I shall only take notice of some few obvious phenomena of one of the most familiar operations, wherein acid and alkali are supposed to be the grand agents. 'Tis a known thing, that *Aqua regis* will dissolve gold, copper, and mercury; and that with these metals, especially with the second, it will produce an intense degree of heat. If now the cause of this heat be demanded, it may be expected, that the patrons of acid and alkali will answer, that 'tis from the action of the acid salts of the menstruum upon the alkali they meet with in the metals. But it is easy to discern, that this answer names, indeed, two supposed efficients of heat, but does not declare how these agents produce that quality; which depends upon a certain, vehement, and various agitation of the insensible parts of bodies. And, therefore, gold and copper, by bare concussion, may be brought to an intense degree of heat, without the accession of any acid particles to work upon them. But, further, when I am told, that *Aqua regis*, by its acidity working on the metalline alkali, makes a dissolution of the metal; I am told, indeed, what they think to be the agent in this change, but not at all satisfied how this agent effects it; for, copper being a very hard metal, and gold generally esteemed, by chymists, the closest and compactest body in nature, I would gladly know, by what power such weak, and, probably, brittle or flexible bodies, as acid salts, are enabled with that force to disjoin such solid, and closely coherent corpuscles, as make up the visible masses of copper and gold; and shatter them with that violence, as, perhaps, to toss up multitudes of them into the air. And since in the dissolution of these metals, there is another phenomenon to be accounted for, as well as the forcing of the parts asunder; the sustentation of the metal in the menstruum; the chymists would greatly inform me, by well explaining how their acid and alkali are able to sustain, and give fluidity to the corpuscles of the dissolved metal; which, tho' it be but copper, is nine times as heavy as an equal bulk

of

of water; and if it be gold, is nineteen times heavier than the liquor that muſt ſuſtain it; and, at leaſt, ſeveral times heavier *in ſpecie* than the ſalts that are mixed with the aqueous parts, can make the menſtruum compoſed of them both: at the ſame time, experience has aſſured me, that if a piece of wax, or any like matter, be made leſs than the hundreth part heavier than an equal bulk of water, it will, when thoroughly immerſed, fall to the bottom, and reſt there. I might further aſk, why, as *Aqua regis* diſſolves mercury, without being much changed in colour by it, gold retains its own yellowneſs in the ſolvent; and why the ſolution of copper is of a colour quite different from that of the metal which affords it, and from that of the ſolvent? In ſhort, thoſe hypotheſes greatly hinder the progreſs of human knowledge, that introduce morals and politics into philoſophy, where all things are tranſacted according to mechanical laws.

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The PREFACE.

WE have now traced Mr. Boyle *to the laſt ſtage of his philoſophical works, that of medicine. And, as I doubt not, he has hitherto ſhew'd himſelf a much greater philoſopher than the world, for want of a thorow knowledge of his writings, ever eſteem'd him; ſo, here he appears a much greater phyſician than he generally ſeems to have paſſed for.*

'Tis true, in ſhewing, by way of introduction, the uſefulneſs of philoſophy to medicine, he manifeſted an uncommon skill in diſeaſes, and the human ſtructure; but, I know not how, his philoſophic capacity appears to ſwallow up his medicinal one, till we come to conſider him ſtrictly as a phyſician; and then he ſhews a maſterly genius, and a very wide command in medicine. But never actually taking the profeſſion upon him, and, conſequently, often wanting the proper opportunities of ſeeing the ſucceſs of remedies applied in particular caſes, he was generally obliged to make his medicinal experiments by other hands. And if we may judge from what appears, thoſe perſons to whom he committed any of his medicines with this view, were ſeldom ſo uncourtly as to bring him an account of their failure; but when the wiſh'd ſucceſs attended their exhibition, he was ſure to be told it in the moſt obliging manner. And hence, to omit other things, it poſſibly is, that Mr. Boyle *recommends* Ens veneris, *as a ſpecific for the rickets; which, tho' a ſerviceable medicine, when rightly tim'd in this diſeaſe, ſeldom, of it ſelf, performs the cure.*

On the other hand, our author was well aware of the accidents and uncertainties which daily occur in practice. He tells us expreſly, that he does not ſet down medicinal experiments with the ſame poſitiveneſs he does thoſe in philoſophy; nor venture his reputation upon the ſucceſs of any receit or proceſs in medicine. Theſe, however, "ſays he, "I always deliver faithfully; nor have I, upon uncertain rumours, recorded the virtues of particular remedies, which may be good, without being infallible." We may take him, then, upon the whole, as a phy-

a physician; for he, doubtless, makes good the character: and, had it been his fortune to have practised the art, he would, I question not, have improved it still more than he has. He had a strange sagacity in discovering the origin of diseases: he appears to have thoroughly considered their manner of acting upon the human frame; and to have hit upon the method of curing them by very plain and simple medicines: witness the piece which concludes this last general head of our abridgment.

There are some, indeed, who have thought fit to censure that admirable collection of remedies, as worthless: and truly we should have been obliged to them, if they had furnish'd the world with a better: but till this is done, which, I am afraid, it will not soon be, we are to consider, that our author's view was here to offer the generality, and such who live at a distance from physicians, a set of remedies, which might soon, with little trouble, and great cheapness, be prepared, as occasion required. And will any man say, that the book does not answer this design? Where, then, lies the cause of blame? The remedies, cries one, are simple, such as the good women prescribe, and some of them appear ridiculous. But we are to know, that Mr. Boyle, *if the nature of his design had required it, cou'd have prescribed as elegant compounds as any physician who has wrote; but of such he had, for weighty reasons, no great opinion; and these simple ones answer his end much better than the other. The remedies contain'd in this collection too, had been long experienced, and found effectual, before he communicated them to the publick.*

'Tis, we must own, a difficult thing to set down a large number of simple, serviceable, and experienc'd remedies, and keep them from appearing ridiculous to such as have seen little in physic; but the men of experience and of judgment in the art, who know how slight and how unpromising a remedy sometimes, apparently, performs great cures; and how powerful and experienc'd ones sometimes fail, are not forward to censure a medicine for appearing contemptible, especially after it has been tried, and found effectual.

In short, whoever publishes a collection of remedies, well adapted to the occasion, approved by experience, easy to be procured, and cheap in the purchase, all which recommendations go along with these of Mr. Boyle, *cannot but deserve well of mankind.*

ME-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

18. *The artificial or chymical analyſis of human blood; and firſt of its ſpirit.*
19. *The volatile ſalt of human blood, and its figures.*
20. *The phlegm of diſtilled human blood.*
21. *The two oils of human blood.*
22. *Its fixt ſalt.*
23. Terra Damnata.
24. *The proportion of the differing ſubſtances, chymically obtained from human blood.*
25. *The fermentation or putrefaction of human blood, and its phenomena.*
26. *The mechanical uſes of human blood, as in husbandry, &c.*
27. *The chymical uſes of it.*
28. *The medicinal uſes of human blood.*
29. *The difference between human blood in ſound perſons of different conſtitutions, and in different circumſtances, as men, women, children*, Moors, Negroes, *&c.*
30. *The affinity and difference between the blood of men and that of other animals, as quadrupeds, birds, fiſhes, and ſanguineous inſects.*
31. *Particulars omitted, relating to the hiſtory of human blood.*
32. *Miſcellaneous obſervations, experiments, and inquiries about human blood.*

SECT. I.

MEDICINE.

The heat of human blood, newly extravaſated.

I Have learnt by inquiry, that ſeveral perſons, free from a fever, have, after their blood had run out a while, upon phlebotomy, complain'd, they found it come ſenſibly hotter than before; and ſome, that it came with a degree of heat that was troubleſome, and, as they fancied, ready to ſcald them.

I deſired a chirurgeon, to put a ſealed weather-glaſs into the porringer, wherein he was going to bleed a young gentlewoman, ſo that as the blood ran out of the open vein, it might fall upon the ball of the inſtrument; in which the liquor was made, by the warmth, to aſcend about an inch.

But having procured a man of a middle age, who ſeemed healthy, to bleed in the ſame manner, upon the ſame weather-glaſs; the ſpirit of wine aſcended above all the marks belonging to the ſtem, and ex-

expanded it ſelf conſiderably in the ſmall upper ball; ſo that tho' we could not determine how high it would have riſen, if the ſtem had been long enough, yet it ſeem'd manifeſt, that the warmth, which made it riſe, conſiderably exceeded the uſual warmth of the air in the dog-days; theſe gaged thermoſcopes being ſo fram'd, as to keep the liquor in the ſtem all the year long, without ſinking quite into the greater ball in winter, or aſcending into the leſs in ſummer.

We employed, alſo, when a young woman was blooded, a ſealed thermometer that was not gaged, but was much ſhorter than the other; and in this the ſpirit was raiſed almoſt to the top, which argued a conſiderable degree of heat.

The ſame thermometer being plunged into ſome blood of a healthy man, tho' it was already coagulated, it ſtill retained warmth enough to make the ſpirit of wine aſcend, at leaſt three or four fingers breadth.

Its inflammability.

Since human blood affords a conſiderable quantity of oil in diſtillation, it may well be ſuppoſed a combuſtible body; but every one will not think it ſo inflammable, as I, upon trial found it. For having held a piece of human blood, dried till it was almoſt pulverable, in the flame of a candle, it would take fire, and afford a flame much like that which excited it; burning with a crackling noiſe, and here and there melting. But this inflammability much better appeared, when putting together four or five throughly kindled coals, we laid on them a piece of dried blood, of the bigneſs of a ſmall nutmeg; for this yielded a large and very yellow flame; and if it were ſeaſonably and warily blown, from time to time, as the effluvia degenerated into ſmoke, it would very long continue to yield clear and yellow flames, conſiderably large, in proportion to the body. And during a large part of this deflagration, the blood appeared, as it were, to fry upon the coals, and, in great meaſure, to melt into a black ſubſtance, almoſt like pitch. There was, alſo, a crackling noiſe produc'd, like that which chymiſts obſerve, when they decrepitate common ſalt.

Theſe experiments were repeated with the like ſucceſs. But there is another ſurprizing inſtance of the inflammability of human blood: for, having cauſed ſome to be ſo far dried, that it was reducible to fine powder, I took part of this powder, that had paſs'd a fine ſearce, and caſting it on the flame of a good candle, the grains, in their quick paſſage through it, took fire; and the powder flaſhed, not without noiſe, as if it had been roſin. This experiment was, alſo, repeated with ſucceſs.

And ſpecific gravity.

The ſpecific gravity of human blood is more difficult to determine, than one would readily imagine. For it may differ ſenſibly in ſeveral perſons, with their ſex, age, conſtitution, &c. and in the ſame perſon it may be varied by the time of the year, and of the day; and by being drawn at a greater or leſs diſtance from eating, &c. beſides all this, there is a mechanical difficulty attending the experiment it ſelf; for the blood begins to coagulate ſo ſoon after it

MEDICINE.

is emitted, that it is ſcarce practicable to weigh it hydroſtatically, either by immerſing into it a ſolid body heavier than it ſelf; or by plunging the whole in water; the former way being oppoſed by the fibrous part of the blood, and the latter by the ſerum. And, upon the ſame account, it is, alſo, difficult to compare, with any accuracy, the weight of blood: however, it may be of conſiderable uſe, to have ſome tolerable eſtimate of the difference in gravity between water and human blood; by which ſo many parts of the body, conſiſtent as well as fluid, are, by various changes of texture, both conſtituted and nouriſhed.

We, therefore, took the blood of a ſound man, emitted all at one time, and put the whole maſs, as well the ſerous as the fibrous part, into an oblong glaſs, of the fitteſt ſize and ſhape we could procure. And having ſuffered the blood to teſt till all was ſettled, and the bubbles vaniſhed, we carefully mark'd, with a diamond, that narrower part of the glaſs, to which the upper ſurface of the blood reached. Then we weighed the glaſs and the blood in a very good balance, and having pour'd out the blood, and waſh'd the glaſs, it was filled with common water, to the ſame mark, and weighed again in the ſame balance; afterwards the water being poured out, the glaſs, alone, was counterpoiſed in the ſame ſcales; and its weight being deducted from each of the two preceding weights, the water was found to be nine ounces, ſix drams, and fifty grains; and the blood ten ounces, two drams, and four grains: ſo that the difference between them being three drams, and fourteen grains, the blood was heavier than ſo much water by about the 25th part of its own weight.

What things coagulate the blood.

Tho' rectified ſpirit of wine be a menſtruum, conſiſting of very ſubtile parts, and, upon that account, a good diſſolvent of many vegetable ſubſtances, and, as experience has aſſured me, of ſome metalline ones too, which ſeem more ſolid than the fibrous part of human blood; yet having ſeparated from the ſerum, a clot of blood, that was coagulated, but ſoft, I kept it for ſeveral hours in a very well dephlegmed vinous ſpirit; from whence I afterwards took it out, as hard as if it had been well dry'd by the fire.

Having almoſt filled a vial, capable of containing near a pound of human blood, with a mixture of that, and ſome rectify'd ſpirit of wine, by gueſs a fourth, or an eighth part; at the end of above three years, looking upon the ſame glaſs, ſtopt with nothing but a cork, we found it coagulated, or of a conſiſtent form: when the veſſel being unſtopp'd, there appeared no ſign of putrefaction in the blood; and having ſmelt to it, we could not perceive that it was fetid: ſo balſamic a vertue has dephlegmed ſpirit of wine to preſerve it.

We took a piece of fibrous, or concreted blood, of the bigneſs of a large bean, and having put it into a ſmall glaſs veſſel, with a flattiſh bottom, we poured on it as much highly rectify'd vinous ſpirit, as might ſerve to cover it, tho' it had been twice thicker than it was; then

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MEDICINE.

The volatile ſalt of human blood, heterogeneous.

The volatile ſalt of human blood, tho' very fugitive, is yet ſo fuſible, that if it be dextrouſly managed, one part of it may be brought to melt, and, as I have tried, even to boil, whilſt the reſt is flying away. The like I have tried with ſome other volatile ſalts, and, I preſume, the obſervation will hold in moſt, if not in all of them.

Tho' the volatile ſalt of human blood, when 'tis, by ſublimation, made white and clean, ſeems to be very homogeneous; yet I am apt to ſuſpect, either that its ſubſtance is not altogether ſimilar; or that its component corpuſcles are of different ſizes, and perhaps of different ſhapes. For having weighed out ſome grains of a re-ſublimed ſalt of human blood, that ſeemed very pure, the odour was ſo ſtrong and diffuſive, that one would have expected the whole ſalt, being but ſix grains, ſhould, in a few hours, evaporate away; eſpecially being left in a ſouth window, expoſed to the air on a flat piece of glaſs: yet ſeven or eight days after, the ſalt ſeem'd to have waſted but little; and what remain'd, had ſcarce any odour at all: notwithſtanding which, this white body retain'd a ſaline taſt; and a little of it being put upon a ſolution of common ſublimate in fair water, readily turned it white. Whence it ſeemed, that the penetrating and diffuſive odour of the volatile ſalt of blood proceeded from ſome particles much more ſubtile and fugitive than the other parts which compoſed it.

Its temperature.

A dram of volatile ſalt of human blood, ſublimed in a lamp-furnace, was put into as much common water, as in a narrow cylindrical glaſs ſerved to cover the whole ball of our ſtandard thermometer, and

ſpirit of ſal-armoniac. *Sydenham*'s liquid laudanum, ſpirit of hartſhorn, the juice of ſage, lavender, maſter-wort, penny-royal, and wormwood, made it more florid, but not much thinner than the decoction of ſavin. *Feb.* 13. the colour turn'd a little browniſh. *Jones*'s panacea of opium had the ſame effect with the laudanum; only on *Feb.* 13. the colour was leſs bright. Both rue-water and wormwood-water gave it a very great degree of fluidity, which remain'd unaltered on *Feb.* 13. Spirit of wine turn'd it to a coagulum, tough as bird-lime. On *Feb.* 13. it reſembled the conſerve of hipps, both in colour and conſiſtence. Spirit of wine with camphire, and a tincture of opium made with it, had the ſame effect; only the coagulum was leſs viſcid. The tincture of *Peruvian* bark made with ſpirit of wine, render'd the blood exceeding thick and dark. On *Feb.* 13. 'twas ſomewhat brighter; but ſtrongly concreted. Wine ſatured with the ſame bark infuſed in it, gave it a very great degree of fluidity, and a moſt beautiful colour. A tincture of jalap, of ſcammony, and compound ſpirit of lavender, made the colour ſtrong and bright, and the ſubſtance thick. Tincture of amber and of tartar, turn'd it into a duſky colour and clots; and on *Feb.* 13. it was pretty ſtrongly coagulated. Calomel gave it a vivid red, and a great degree of fluidity; much ſerum floating on the top. Æthiops mineral precipitated a black maſs out of it, and left the other ſufficiently thin. Salt of broom gave it a vivid colour, and a greater degree of fluidity than is natural to it. Salt of wormwood greatly increaſed its colour and fluidity. Salt of tartar altered not its colour, but render'd it ſomewhat thicker than did ſalt of wormwood. *Lower*'s chalybeate tincture made it very red and thin; ſomething like an oily froth ſwimming on the top. *Emmenolog. p.* 160, 161.

when,

when, after this had ſtood a while in the water, in order to become of the ſame temper with it, we put in the ſalt, the tinged ſpirit of wine manifeſtly ſubſided about two tenths of an inch, and probably would have fallen lower, if there had been more water in the veſſel, to make a ſeaſonable ſolution of the ſalt, whereof a conſiderable part lay undiſſolved at the bottom. MEDICINE.

When we perceived the liquor to ſubſide no more, we put to it, by degrees, ſome ſtrong ſpirit of nitre, till it would no longer make any manifeſt conflict with the diſſolved ſalt. The event was, that the liquor in the thermometer began preſently to mount, and continued to do ſo as long as the conflict laſted; at the end of which we found, that it had aſcended more than three inches and a half, above the ſtation it reſted at when the ebullition began.

Its figures. The figuration of the volatile ſalt of human blood may be conſidered, either in regard of the ſingle grains, or of that aggregate of them, which, when made to aſcend to the top of the glaſs, may be call'd its ſublimate. The latter of theſe may be beſt obſerved, when the ſaline exhalations firſt aſcend, and faſten themſelves to the inſide of the glaſs that is ſet to receive them. For tho' towards the end of the operation, the corpuſcles lie ſo thick and confuſed, as to leave no diſtinct figures; yet, at firſt, one may often obſerve the little ſaline concretions placed in rows, ſometimes ſtreight, and ſometimes more or leſs crooked, with differing occurſions and coherencies; ſo that tho' ſometimes ſuch rows of concretions may repreſent either trees, their branches, hartſhorn, *&c.* yet theſe ſeem not to be conſtant repreſentations, depending upon the particular nature of human blood; but caſual figurations, that depend upon ſeveral accidental cauſes and circumſtances; ſuch as the degree of fire employed to ſublime the ſalt, *&c.* Nor is the ſalt of human blood the only volatile one, among whoſe elevated concretions I have obſerved the like circumſtances to produce diverſity of configurations. But as to ſingle grains of the volatile ſalt of blood, I diſcerned many of them to be finely ſhap'd; tho' whether it were accidental or not, further tryal muſt inform me. I could not, that I remember, obſerve theſe handſome figures in the concretions which compos'd the ſublimate, obtained by rectifying, or elevating again, the ſalt that firſt came over, but in the grains that, in the firſt diſtillation, faſten themſelves to the upper part and ſides of the receiver; for ſeveral of theſe were of conſiderable bigneſs and ſolidity: and tho' they were not all of the ſame ſhape; ſome of them being not unlike to cubes, others to parallelopipeds, and others to octoedrons; yet moſt of them were prettily ſhaped, being comprehended by ſmooth planes, finely figured, and aptly terminating in ſolid angles, as if the concretion had been cut and poliſhed by a jeweller.

There is another way that I have uſed to obſerve the figures of the ſalt of blood; which was to rectify the ſpirit of blood, ſo that it might be fully ſatiated with the ſalt, whilſt the liquor (in their receiver)

ver) continued yet ſomewhat warm. For then ſetting aſide this over-impregnated liquor; when it came to be quite cool, there appeared at the bottom of the vial a large number of ſaline concretions of diffeting ſizes; ſeveral of which, as far as the reſt would ſuffer me to ſee them, were ſhot into cryſtalline plates, very ſmooth, and prettily figured; having their broad and parallel ſurfaces of a hexagonal or regular octogonal figure.

We took a dram of dry volatile ſalt of blood, and having diſſolv'd it in diſtill'd water, we dropt into it good ſpirit of nitre, till the two liquors, tho' they were ſhaken, would no longer manifeſtly act upon one another; the conflict being ceas'd, we ſlowly evaporated the ſuperfluous moiſture, which ſteam'd almoſt all away before the ſaline part would coagulate. At length it became dry, and then the middle part appeared in the form of thin cryſtals, like thoſe of ſalt-petre; but the reſt, which was by much the greater part of the concretion, ſeem'd to be a confuſed maſs, without any diſtinct figure. This maſs weighed but one dram and twelve grains; ſo that, as far as this ſingle experiment can inform us, the volatile ſalt of blood may be ſatiated by a fifth part of its weight of the ſaline corpuſcles of ſpirit of nitre. This compounded ſalt being laid in a window, appeared apt to reſolve by the moiſture of the air; and a little of the ſaid ſalt being put on a well-kindled coal, readily melted, and ſeem'd to boil, and towards the latter end, made a noiſe, and afforded a flame very like common nitre, only its colour was more yellow. The ſtrong ſmell that accompanied this deflagration, was like that peculiar to ſpirit of nitre.

To try how much volatile ſalt an aſſigned quantity of water wou'd diſſolve, we took three ounces of diſtill'd water, and put into it, by degrees, ſome dry white ſalt of ſal-armoniac, keeping the liquor in digeſtion till it had diſſolved as much as it cou'd; then we took it out, and found, that after ſtanding for ſome hours in the cold, there ſettled about the bottom of the glaſs, a conſiderable quantity of ſalt, ſuppoſed to be two drams; which being deducted from two ounces, which had, in all, been employed, there remains one ounce and ſix drams in the liquor, which, by this account, had diſſolved above half its weight of ſalt.

Diſpoſition to diſſolve in water.

Having cauſed an ounce of diſtill'd water to be carefully weigh'd out, we put into it, little by little, ſome dry white volatile ſalt of blood, and ſhook it well into the liquor, to make it diſperſe the better; we allowed it, alſo, a competent time for ſolution, and by this means found, that one ounce of water would diſſolve at leaſt two drams, that is, a fourth part of its weight, of dry ſalt, and that in the cold. Afterwards, by the help of heat, we made the ſame liquor diſſolve near five and twenty grains more.

We put this ſolution into a retort, to be drawn off with a quick heat, and thereby had a diſtill'd liquor, that contain'd all the volatile

ſalt,

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retort, an empyreumatical and very fetid oil, whoſe colour was almoſt black; but that ſeem'd to proceed only from the intenſe and opake redneſs of the liquor, ſince ſome portions of it being viewed againſt the light, when ſpread very thin upon glaſs, appeared of a deep yellow, or of a reddiſh colour, as they chanced to lie more or leſs thick.

When the blood was well dry'd, before we committed it to diſtillation, I found it to afford a greater quantity of oil, in proportion to the weight of the dry body, than was at firſt expected. Once, out of a pound of it not over-dry'd, we had near an ounce and an half of oil; and from another parcel, we had it in a far greater proportion to the quantity of blood that afforded it.

Having prepared blood, by a very convenient digeſtion, and rectified, very carefully, the diſtilled liquors that came over, with the flame of a lamp; I obtained, among other things, two oils of very different colours; the one of a yellow, or pale amber, and the other of a deep red. But it was ſurprizing, that tho' theſe oils were both of them afforded by the ſame blood, and were clear and pure, yet they would not only ſwim in diſtinct maſſes one over another; but, if they were confounded by being ſhaken together, would gradually ſeparate again, as common oil and water. Whether the difference in ſpecific gravity between theſe two oils, could keep them from permanently mixing, as it kept their maſſes diſtinct before they were ſhaken; or whether this ſeeming antipathy proceeded from ſome particular diſagreement in the textures of theſe liquors, I ſhall not here conſider.

Suſpecting that the oil of blood might contain ſaline particles, capable of being ſeparated from it, we took a parcel of unrectified oil of human blood, and having put to it a convenient quantity of diſtill'd water, we throughly confounded theſe liquors by frequent agitation, that the water might rob the oil of its ſeparable ſaline corpuſcles; and after the liquors were well ſettled, the water was found impregnated with ſaline corpuſcles, that it had, by diſſolution, obtained from the oil; by virtue of which, it was endowed with a moderately briſk taſt, would readily turn ſyrup of violets green, precipitate a white powder out of a ſolution of common ſublimate, and otherwiſe reſembled weak ſpirit of human blood.

We put ſome unrectified oil of human blood, into a concave piece of glaſs, and having dropt into it as much oil of vitriol, as might amount to a fourth, or a third part of the fetid oil, we ſtirr'd them well together with a ſlender piece of ſolid glaſs; by which means the mixture was made to ſend up abundance of whitiſh fumes, or ſmoke, and grew ſo hot, that tho' the quantity was above a ſpoonful, yet, without pain and inconvenience, I could not hold my finger underneath the containing glaſs.

Having taken ſome unrectified oil of human blood, tho' in that ſtate it appeared groſs, dark, and muddy, yet it would readily, even

in

in the cold, diſſolve in, or mix with high rectified vinous ſpirits, to which it communicated a deep reddiſh colour.

Fixed ſalt.

I do not remember to have any where met with an account of the qualities of the fixed ſalt of human blood, and I know not whether any one has prepared it; and no wonder, ſince to obtain ſo much as one ounce of it, there is requiſite a conſiderable quantity, perhaps ſome pounds of blood; and the calcination requires ſo obſtinate a fire, that a man's patience may eaſily be tired before the operation be perfected; or, by the ſmall appearance of calcination, that the *Caput mortuum* will afford him, after having been kept for three or four hours in the fire, he may be induced to conclude, that all the ſalt of blood is volatile in a large fire; and, conſequently, that it will yield no fixt ſalt.

But having, by an obſtinate calcination, obtained between three and four drams of this ſalt, I found not that it was a fix'd alkali, or a lixiviate ſalt, but rather of the nature of common or ſea-ſalt; tho' not without ſome little difference, which diſcover'd it ſelf by ſome nice triáls. But, in the general, our ſalt was ſcarce diſtinguiſhable from marine ſalt; for it taſted very like that; and a ſtrong ſolution of in did not readily turn ſyrup of violets green or greeniſh, nor precipitate a brick-colour'd, a browniſh yellow, or a white powder, out of a ſolution of ſublimate. I alſo found, that the ſpirit of ſalt did not diſſolve it as an alkali. Having put ſome oil of vitriol upon a little of our dry ſalt, that immediately corroded it, with great violence, and with much foam and ſmoke, as it does common ſalt. We, alſo, dropt a little of our fix'd ſalt, diſſolved in diſtill'd water, upon a ſolution of fine ſilver, made in *Aqua fortis*, whence immediately enſued a large precipitation of a white powder. And, laſtly, having put ſome leaf gold into *Aqua fortis*, and added a little of our powder'd ſalt to the liquor, it was thereby turned into a kind of *Aqua regia*, and did in a trice, without the aſſiſtance of heat, totally diſſolve the gold.*

Caput mortuum.

A far greater calcination than one would expect, is required to obtain the *Caput mortuum* of human blood, which affords but very little of it. For from twenty four ounces of dry'd blood, we could get, after two days calcination, but two drams, and nine grains of

* That an acid, or what is commonly called ſo, and judged of by the change of colour it cauſes in ſyrup of violets, &c. may be drawn from the blood of animals in general, and from human blood in particular, ſeems proved by the repeated experiments of M. *Homberg*; who, for greater ſecurity in the analyſis he made of them, employed for his addition only the *Caput mortuum*, or friable ſpongy coal of animal blood it ſelf; whilſt M. *Vieuſſens* made uſe of bole, &c. in his diſtillations. From hence, and from the careful analyſis which this great chymiſt has alſo made, of plants, and the fleſh and excrements of ſeveral animals, particularly the human; it appears, that the acid, (or ſea-ſalt,) of the aliment taken into the bodies of animals, is not deſtroyed therein, but paſſes into the ſubſtance of them; the ſuperfluous portion being return'd unalter'd along with the excrements. See *Memoir. de l' Acad.* A. 1712. p. 9—18. and p. 352—363.

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earth. And tho' this were ſo carefully made, that it may very probably be ſuppos'd to deſerve the name of *Terra damnata*, better than moſt ſubſtances to which chymiſts uſually give that appellation, yet one may ſuſpect, that this it ſelf was not pure elementary earth; ſince it had a red colour, very like that of colcothar of vitriol.

The proportions of its principles upon a chymical analyſis.

The quantities of the principles, or rather of the ſeveral differing ſubſtances obtainable, by diſtillation, from human blood, are very difficult, if poſſible, to be determined; becauſe of the great diſparity, as to proportion, that may be met with, of the fibrous, or concreted part to the ſerum, in the blood of different perſons, and even of the ſame perſon, according to different circumſtances; and becauſe it is more difficult to diſtil even the dried and pulverable part of blood, without addition, than thoſe who have not try'd will eaſily imagine: and I doubt few have try'd it well, becauſe I have not met with any who take notice of the neceſſity of ſhifting the retort, to gain as much volatile ſubſtance as may be obtained, and leave as little as poſſible in the *Caput mortuum*. For when we diſtilled a conſiderable quantity of dry'd blood, tho' it was warily done by an expert artiſt; yet the ſame heat that made the lower part of the blood paſs, in the form of exhalations, into the receiver, made the ſubject ſo ſwell, that it raiſed to the upper part of the veſſel a conſiderable quantity of black matter, which an ordinary operator would have thrown aſide for *Caput mortuum*, tho' a heedful eye might eaſily diſcern it to be much of the ſame nature with what was firſt put in, but blacked by the aſcending fumes. We, therefore, took it out, and mixing it with the remaining ſubſtance, that was leſs remote from the nature of a true *Caput mortuum*, it was again, in another retort, committed to diſtillation; whereby we obtained more oil, *&c.* And perceiving even this ſeeming *Caput mortuum* had, at the top of it, a pretty deal of matter, that I did not think ſufficiently diſpirited; I cauſed it to be taken out, and diſtill'd in a freſh retort, in which it afforded a conſiderable quantity of volatile matter.

And having thus, in three retorts, diſtilled twenty-four ounces of dry'd human blood, we obtained of volatile ſubſtances, I mean ſpirit, together with a little phlegm, white ſalt, and a very high-coloured oil, thirteen ounces, and one dram; beſides ſeveral parcels of thick oil, that ſtuck to the retorts and the receivers, which we eſtimated at ſeven drams more. So that the whole quantity of the volatile part amounted to fourteen ounces, of which we found the oil to be about three ounces, and ſix drams; and the clear liquor ſix ounces, three drams and an half; beſides the volatile ſalt, which, when the ſpirit was detain'd from it, appeared white, but wet: for which reaſon 'twas not poſſible to determine exactly, neither how much liquor it yet retained, nor, conſequently, how much it ſelf weigh'd. But having carefully ſublimed the ſalt, there remained in the glaſs two drams, and about five grains of phlegmy liquor, which was not judged free

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ſtance, two ounces two drams. This pulverable matter being beaten, put into a retort, and diſtill'd in ſand; by degrees of fire, afforded two drams forty-eight grains of oil. But there happen'd an unlucky miſtake about the ſalt and ſpirit: for after the latter was poured off, which weighed but forty-eight grains, the wet ſalt, which ſtuck in a large quantity to the lateral and upper parts of the receiver, inſtead of having been waſh'd out, with the phlegm of the ſame blood, was waſh'd out with diſtill'd water, whence we obtain'd by ſublimation, into the neck of a glaſs-egg, one dram and five grains of dry ſalt. But, by the taſt of the diſtill'd water, whence it was ſublimed, it appeared, that all the ſalt had not been raiſed: I, therefore, put to it as much good ſpirit of ſalt as I ſuppoſed to be at leaſt ſufficient to ſatiate it, with deſign to try, whether by evaporating this mixture to dryneſs, and ſubliming the ſalt by the help of an alkali, we might not recover the volatile ſalt, that had been ſomewhat fixt by the acid ſpirit. The retort being broke, that the *Caput mortuum* might be taken out, it was found to weigh ſix drams and twelve grains; which being carefully calcined, yielded but two ſcruples and four grains of aſhes, which were red. Theſe being elixiviated, afforded eighteen grains of ſalt, beſides the remaining earth or terreſtrial ſubſtance, which I keep by me; becauſe, notwithſtanding all the violence of the fire it has undergone, 'tis of a red colour, with an eye of purple.

SECT. II.

Obſervations upon the ſerum of human blood.

A Young man having bled into a porringer, and the blood having been kept for ſeveral hours, that a ſufficient ſeparation might be made of the conſiſtent part and the fluid; they were ſeparately weigh'd, when the former amounted to about ſix ounces, and the ſerous part to near the ſame weight.

Since the diviſion that nature herſelf makes of human blood, when being let out of the veins, and ſuffered to cool and ſettle, is into a fluid or ſerous, and a conſiſtent or fibrous part; and ſince 'tis often found, that the former of theſe parts either equals or exceeds the latter in quantity, I thought it might conduce to ſhew the nature of the blood, to make ſome tryals upon the ſerum apart.

Its proportion to the red part.

And firſt, having weigh'd the ſerum, and the conſiſtent part of a parcel of human blood, obtained, at once, by a ſingle phlebotomy, we found the latter to be four ounces ſix drams and an half, and the former three ounces and ſix drams. And having made the like tryal with another parcel of blood, drawn from another perſon, the fibrous part weighed four ounces, five drams; and the ſerum four ounces. But tho' in both

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both theſe tryals the weight of ſerum that appeared in one maſs, was inferior to that of the fibrous part; yet it could not be ſafely inferred, that, abſolutely ſpeaking, the fibrous part of either of theſe parcels of blood exceeded the other; ſince we weighed only the ſerum that we found in a diſtinct maſs; whereas a multitude of ſerous particles may well be ſuppoſed to be lodged between the parts of the conſiſtent maſs; for, probably, 'tis upon account of the interſperſed ſeroſity that it is ſoft; and beſides, it affords a great deal of aqueous liquor. And this may ſufficiently appear by the following experiment, which was purpoſely made, to examine the conjecture.

We took a porringer of blood, wherein the ſerum was ſeparated from the fibrous portion, that was coagulated into one conſiſtent maſs; and having carefully poured off all the fluid part, we put the remaining maſs (which weighed four ounces, five drams, thirty-four grains) into a ſmall head and body, and diſtill'd it in a digeſtive furnace, till the matter, left in the bottom of the cucurbit, was quite dry; then taking out the ſeparated parts of this red maſs, the dried portion was found to weigh one ounce, three drams, thirty-four grains. But the ſerous liquor that paſs'd into the receiver, being limpid and aqueous, without any ſhew of ſalt or oil, amounted to three ounces, fifty-three grains. We repeated this experiment with the fibrous part of another parcel of human blood, and found the dry maſs, remaining in the cucurbit, to weigh one ounce, ſix drams, and fifty grains. But the phlegmy liquor, diſtill'd from it, amounted to ſeven ounces.

Its ſpecific gravity.

Having hydroſtatically examin'd the ſerum of human blood, we found it heavier than common water. For a piece of red ſealing-wax, being ſuſpended in a good balance by a horſe-hair, was found in the air to weigh one dram fifty-ſix grains, and in the water thirty-five grains; but in the ſerum only thirty-three grains. This tryal was confirmed by a more exact one, made with an inſtrument that I purpoſely deſigned for weighing liquors nicely; in which, when common water weighed two hundred fifty-three grains, an equal bulk of ſerum weighed three hundred and two. And ſuppoſing different ſerums of human blood would not be of equal ſpecific gravity, I try'd that of the blood of another perſon in the ſame inſtrument, and found it to weigh two grains leſs, that is, three hundred grains in all.*

We

* Some experiments made by Dr. *Jurin*, ſhew, that the red part of the blood is ſpecifically heavier than the ſerum; that the red globules are not filled with any elaſtic fluid; that the ſpecific gravity of the ſerum drawn off from the red part, is, at a medium, to water 1030. to 1000; but the ſpecific gravity of the blood it ſelf as 1054; whence blood is heavier than ſerum by about one part in 43; that the ſerum, which may be poured from the *Craſſamentum*, with the quantity remaining in the interſtices of the latter, is, probably, about three fourths of the whole; and that the red part of the blood conſiſts of ſome phlegm, united with oil and ſalts, and a ſmall quantity of earth. But, adds this learned gentleman, what is the exact proportion of theſe ſeveral principles to one another; what alterations are produced in the body by the change of this pro-

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We once employed ſome ſerum which was not poured off ſo clear, but that it appeared of a reddiſh colour; and tho' we filter'd it thro' cap-paper, yet a large number of the tinging corpuſcles were ſo thoroughly mixed with it, that the liquor paſs'd thro' the filtre of a yellow colour.

The ſerum of human blood mixed with various ſubſtances.

To try whether acids would coagulate our ſerum, as I had found they would ſome other animal liquors, I dropt ſpirit of ſalt into it, which immediately produced ſome white concretions, that quickly ſubſided to the bottom, and there appeared like a very light and tender cheeſe-curd.

The like operation, but more powerful, oil of vitriol had upon another parcel of ſerum. We alſo dropt into ſome of our liquor, good ſpirit of ſal-armoniac, which made it rather more fluid.

To try whether theſe precipitations did not more proceed from the coalition and texture of the acid ſalts and the ſerum, than barely from the peculiar action of thoſe ſalts as acids, we dropt into another portion of our ſerum oil of tartar *per deliquium*, which inſtantly produced a white curd, as the ſpirit of ſalt had done, but not, as it ſeem'd to us, ſo copiouſly. We poured, alſo, upon ſome ſerum highly rectified ſpirit of wine, which preſently coagulated part of it into a large white curd, that appeared much lighter than any of the former; for it would not, like them, ſubſide; but kept at the top of the liquor.

To try, alſo, what a ſalt compounded with a metal, would do upon our ſerum, we put to it a little ſtrong ſolution of ſublimate, with which it preſently afforded a white and curdled ſubſtance.

We put ſome of our ſerum upon filings of ſteel, but by reaſon of the colour of the liquor it ſelf, we could not ſatisfie our ſelves about the event. And tho' we afterwards put another parcel of ſerum upon filings of the ſame metal, yet neither did this give us ſatisfaction; becauſe the vial having been miſlaid, it was not viewed again till many days after; at which time the liquor was grown ſo thick and muddy, that we could not well diſcern any more of the colour, than that it was ſomewhat dark, but not either black or blackiſh; yet by a tryal or two, that we made with a little of this liquor, it ſeemed to have diſſolved ſome part of the ſteel: for putting it to ſome freſh infuſion of galls made with water, it preſently afforded a large precipitate; tho' this was ſo far from being inky, that it was not ſo much as dark coloured, but rather whitiſh. And having mixed with ſome

proportion; how and in what part the red globules are form'd; by what means they preſerve their figure, without diſſolving in the ſerum, or uniting with one another; what variations are made in their ſpecific gravities by heat and cold, with the effects of thoſe variations, are queſtions not very eaſy to be ſolved, and yet of ſuch importance to the animal œconomy, that it were greatly to be wiſh'd we had ſufficient *Data* to determine them. See *Philoſ. Tranſ. No.* 361. *p.* 1000.

of

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE. came over a large proportion of ſpirituous liquor, which ſmell'd almoſt like the ſpirit of blood, and contained much volatile alkali; ſo that it would readily turn ſyrup of violets green, make a white precipitate in the ſolution of ſublimate, and cauſe a great ebullition with ſpirit of ſalt. This ſpirit being rectified in a ſmall head and body, there was left in the bottom of the glaſs a greater quantity than we expected, of a ſubſtance thick like honey; and which was, for the moſt part, of a dark red, and ſeemed to contain more oil than appeared upon the firſt diſtillation. The liquor that came over the helm ſeemed more pure, but not very much ſtronger, than the firſt ſpirit. Yet having put it into a glaſs-egg, with a ſlender neck, and given the veſſel a convenient ſituation in hot ſand, we obtained a volatile alkali, that ſublimed into the neck, in the form of a white ſalt. This ſhould ſeem to argue, that the ſerous, or fluid part of the blood, affords the ſame elementary principle, or ſimilar ſubſtances, both as to number and kind, with the fibrous and conſiſtent part, tho' not as to quantity; that of the oil and of dry ſalt being leſs in a determinate portion of ſerum, than they would be in a like quantity, or weight, of the concreted part of the blood.

With additions. Having obſerved, that tho' the ſpirituous parts of human urine, require the liquor to be long digeſted, or putrefied, to looſen them from the more ſluggiſh parts, and make them aſcend before the phlegm; yet, if freſh urine be poured upon a due portion of quick-lime, a large part of the ſpirit will preſently be ſet looſe, and made capable of aſcending in diſtillation; I thought it worth while to try, what would be afforded by the ſerum of human blood put upon quick-lime, before we diſtill'd it. In purſuit of this enquiry, we put theſe two bodies together, upon whoſe commixture there enſued a ſenſible, but tranſient heat. This compounded body being committed to diſtillation, afforded, firſt, a kind of phlegm in a gentle fire; and then, in a ſtronger, a moderate quantity of liquor, that was thought to ſmell manifeſtly of the lime, but had not a briſk taſt; tho' accompanied with ſomewhat more of a high-coloured, and fetid oil, than was expected.

The other liquor being ſlowly rectified, the ſpirit that firſt came over had a ſtrong and piercing ſmell, but leſs rank than that of human blood, drawn after the ordinary way. Being dropt upon ſyrup of violets, it preſently turn'd it green; with a ſtrong ſolution of ſublimate in water, and another of quick-ſilver in *Aqua fortis*, it immediately made two white precipitates; and being mixed with good ſpirit of ſea-ſalt, tho' upon their being confounded there appeared a thick, but whitiſh ſmoke; there was not produced any conflict or bubbles; tho' the colour of the ſpirit of ſalt appeared much heightened by this operation. And having put the mixture of the ſpirit of ſerum, and of ſalt, to evaporate, that we might obſerve whether it would afford a ſalt figured much like ſal-armoniac; we found that it did not; but that the colour produced

in

in the mixture whilſt fluid, was ſo heightned in the concretion, that it appeared of a blood-red colour; but for the ſhape, it was ſo confuſed, that we could not reduce it to any known kind of ſalt. By all which phenomena, this ſpirit of the ſerous part ſeems to be very near of kin to that of the concreted part of blood.

Quick-lime being ſuſpected of a cauſtic and fretting quality, I thought fit to try, whether the fix'd ſalt of pot-aſhes being ſubſtituted in the room of it, would, in diſtillation, have the ſame effect upon ſerum of human blood. Wherefore, to four parts of the liquor, we put one of the ſalt; and having diſtill'd them, ſlowly, in a glaſs head and body, we obtained much of a liquor, which was not judg'd any thing near ſo ſtrong, as that drawn off from quick-lime. And, having put this weak liquor, afforded by our ſerum, to rectifie with a gentle heat, we found even the two ſpoonfuls of liquor that firſt aſcended, were very phlegmy; nor would it well turn ſyrup of violets green, tho' it afforded ſome little and light precipitate when put upon a ſolution of ſublimate.

This will ſeem the more remarkable from an experiment that may be ſometimes of practical uſe, eſpecially in phyſic; and may afford light to thoſe who are ſtudious to know the nature and preparations of human urine. We took, then, three parts of freſh urine, and having put into it one part of ſalt of pot-aſhes, and ſlowly diſtill'd them in a head and body; there firſt aſcended a ſpirituous liquor, which being ſet aſide, we continued the diſtillation in a retort, till the remains appear'd dry. In the operation we obtained not one drop of oil; whilſt this ſpirit of urine was not near ſo fetid, as that made in the common way; and the liquor that came over toward the latter end of the diſtillation, was ſo unlike that which the ſerum of blood afforded, that it was not only conſiderable ſtrong, and manifeſtly ſtronger than that which firſt aſcended, but had a penetrating and fiery taſt, which left a laſting impreſſion upon the tongue; and with good ſpirit of ſalt it made a notable ebullition, which the ſpirit of urine, drawn fron quick-lime, did not. And tho' with this laſt liquor, I never found any volatile ſalt to aſcend, in a dry form; yet in the operation made by the help of ſalt of pot-aſhes, there came up, without rectification, ſeveral grains of volatile ſalt, one of which was cryſtalline, and conſiderably large.

But in repeating this experiment, we had not ſo good ſucceſs; the liquor that came over appearing much more phlegmy than before; tho' we both times employ'd ſalt of pot-aſhes, taken out of the ſame veſſel; and the urine of the ſame perſon: yet this liquor that appeared ſo weak at its firſt coming over, being rectify'd *per ſe*, afforded more than was expected of a briſk, ſaline ſpirit; from which we eaſily obtained a large quantity, in proportion to the liquor, of volatile ſalt, in a dry form, and of a very white colour.

MEDICINE.

The ſerum of human blood long kept hermetically ſealed up.

We took between two and three ounces of ſerum of human blood, and having put it into a bolt-head, capable of containing about four times as much, and ſeal'd the glaſs hermetically, we ſet it by.

After we had kept the liquor ſeal'd up for above a whole year, it did not appear to be at all coagulated, nor to have let fall any manifeſt reſidence; but ſeemed to be as fluid as when it was firſt put up.

It did not appear to have bred the leaſt worm, or maggot; and, for my part, I never obſerved worms, or infects, to be generated in blood, tho' very long kept and putrefied, provided it were freſh enough when put into the glaſs; and by an exact cloſure kept from being any way blown upon by flies, or impregnated by ſeminal particles, that may unexpectedly be conveyed to it by the air. Nor did there appear to the eye, any mother, or recrementitious ſubſtance, that is ſuppos'd, in liquors, always to accompany, and betoken putrefaction.

One deſign in our experiment being to try, whether the ſerum would, by the mutual action of the parts upon one another, or by that of ſome univerſal permeating fluid, afford ſo much air, as could either crack, or more violently break the glaſs; the tip, at which we had ſealed the bolt-head, was warily taken off; whereupon there ruſhed out a pretty deal of air, with a conſiderable noiſe: and I doubted not that this generated air had been conſiderably compreſt whilſt it was pent up; when caſting my eyes on the liquor, to diſcover what change this eruption had made there, I perceived on the upper ſurface of it, a multitude of ſmall bubbles, ſuch as appear in ſeveral liquors, after the air has been pent up with them, when the glaſſes come to be unſtopp'd. And thus having ſeal'd up ſome ſheeps blood, and kept it for ſeveral days in a gentle warmth; tho' the containing glaſs were far larger than what held our ſerum; yet after ſome time, when no violence was offer'd to it, it was ſuddenly blown up, with a ſurprizing noiſe, by the aerial or elaſtic corpuſcles that were produced, or ſet free by the putrefaction we diſcovered to have been made.

The ſmell of our ſerum was ſtrong, tho' not cadaverous, but rather reſembled that of the tincture of ſulphur, made with ſalt of tartar, and ſpirit of wine; or of ſome ſuch ſulphureous preparation.

And afterwards diſtill'd.

One principal view I had in keeping our ſerum ſo long ſealed up, was, to try, whether by a digeſtion, or putrefaction, for ſome months, it would, like urine, afford a ſaline ſpirit, or an alkali; volatile enough to aſcend before the phlegm. And committing it to diſtillation, in a ſmall glaſs head and body, in a digeſtive furnace, being careful to take the firſt ſpoonful of the ſpirit that paſs'd into the receiver, we found, that tho' this liquor, at firſt, ſmell'd ſtrong, yet the taſt was not at all briſk, nor ſpirituous, like that uſually obtained, by diſtillation, from putrefied urine. Nor did our liquor, when dropt into ſyrup of violets, preſently give it any manifeſt greenneſs. Yet

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MEDICINE. upon ſome of our frigorific mixture of ice and ſalt; by which means, the ſerum being frozen from the bottom upwards, there appeared, here and there, upon the ice, contiguous to the air, certain figures, reſembling thoſe of frozen urine.

And how made to ſerve for an inviſible ink.

Having obſerved, that human urine would tolerably ſerve for what is call'd an inviſible ink; and conſidering the great affinity that is ſuppos'd to be between urine and the ſerum of blood, I thought fit to try, whether the latter might not be employed, like the former, to make a kind of inviſible ink. To this effect, we took ſome ſerum of human blood, and having dipt a new pen in it, we trac'd ſome characters upon a piece of white paper, and ſuffered them to dry thereon; we then held the unwritten ſide of the paper over the flame of a candle, by which means, the written letters appeared on the upper ſurface of the paper, tho' not of an inky blackneſs, yet of a colour dark enough to be eaſily legible, and very like to ſome others, that having been purpoſely written with freſh urine, and made viſible by heat, were compared with them.*

* Dr. *Freind*, in mixing the following liquors with the ſerum of human blood, obſerved, that each of them turn'd it of a different colour; but that they, ſeverally, gave it a greater degree of fluidity, which continued for a day or two. The liquors were a tincture of aloes, made with mint-water, a decoction of ſavin, ſavin-water, ſpring-water, the decoction of gentian, arum, ſarſaparilla, and china; ſpirit of ſal-armoniac, and of tartar, oil of caraway-ſeeds, *Jones*'s Penacea of opium, *Sydenham*'s liquid laudanum, ſpirit of ſaffron, and of turpentine, *Tinctura martis tartariz.* ſpirit of guaiacum, ſpirit of hartſhorn, and the oils of turpentine, guaiacum, lavender, and cloves. He further found, that a decoction of the *Peruvian* bark rendered the ſerum much more fluid than any of theſe liquors; that ſpirit of wine, with camphire, ſtrongly coagulated it; and that after they had, for ſome time, remain'd together in the vial, there was a large ſediment at the bottom; the upper part of the liquor appearing clear and tranſparent; that rectified ſpirit of wine kept it turbid, without any precipitation; that the tinctures of ſcammony, caſtor, amber, ſulphur, and *Peruvian* bark, moderately coagulated the ſerum; that the tinctures of ſaffron, and of metals, the *Poteſtates ſuccini*, and *Sal. vol. oleoſ.* afforded a light coagulum; and the *Tinc. mart. Mynſic*, a ſtrong one; a concreted maſs, like gum, falling to the bottom; that the diaphoretic tincture of antimony render'd it turbid, and a little concreted; that the tinctures of jalap, and of amber, with ſal-armoniac, render'd it only turbid; and laſtly, that the tinctures of *Spec. diambr.* and cochineal, made with ſpirit of wine, afforded ſcarce any coagulum. See *Freind. Emmenolog. p.* 162, 163.

The decoctions of pomegranat-ſhells, tormentil, and biſtort, being ſeverally put to ſome ſerum of human blood, cauſed it to concrete a little. Tincture of coral coagulated it. Spirit of ſalt concreted a ſmall part of it; but left the other thin and liquid. Spirit of nitre made a ſtrong coagulum; but half the ſerum remain'd fluid. The ſame happened with *Spir. nitri bezoartic.* Oil of vitriol precipitated a coagulum; leaving ſome part liquid. The *Tinct. antiphthiſica* made it turbid, and ſomewhat concreted it. *Aqua fortis*, and *Spir. vitriol. philoſ.* gave a white coagulum. *Aqua ſtyptica* made a very ſtrong concretion. The tincture of *Terra Japon.* gave a red coagulum. A ſolution of ſalt, in common water, made a white concreted maſs; as did, alſo, a like ſolution of nitre. *Emmenolog. p.* 177, 178.

SECT.

SECT. III.

MEDICINE.

HAVING, for want of materials, been reduced to treat the hiſtory of human blood in ſo very imperfect a manner, as to leave many of the primary heads untouched, and others but ſlightly ſpoken to; I ſhall here, by way of ſpecimen, branch one of the primary heads into its ſeveral parts, and treat of each diſtinctly. And ſince the ſpirit of human blood, is one of the nobleſt of urinous or volatile alkalies; ſo that moſt of the things that ſhall be taught concerning it, may, with ſome little variation, be applied to ſpirit of urine, hartſhorn, ſal-armoniac, ſcot, *&c.* I ſhall make choice of that; and give a kind of ſummary of the hiſtory of volatile ſalts, in general. But it will here be neceſſary to take notice, firſt, that the ſpirit I employed in making the following tryals and obſervations, was drawn from human blood, without any ſand, clay, or other addition, except ſome vinous ſpirit to preſerve it; and that the firſt diſtillations were performed in retorts plac'd in ſand; care being taken that the veſſels were not near filled: becauſe blood, if it be not well dry'd, is apt to ſwell much, and paſs into the neck of the retort, if not into the receiver. Secondly, that the blood we made uſe of, was drawn from perſons who parted with it out of cuſtom. And, laſtly, that there being ſo great an affinity between the ſpirit and volatile ſalt of human blood, that, probably, the latter is little other than the ſpirit in a dry form, and the former than the ſalt united with phlegm enough to give it a liquid form; 'tis preſumed, that it may be allowable to conſider the volatile ſalt of blood as its dry ſpirit.

Subordinate heads for the hiſtory of the ſpirit of human blood.

1. *The ſeveral ways of diſtilling human blood.*
2. *Whether human blood may be ſo ordered, by fermentation or putrefaction, that, in diſtillation, a ſpirit, either urinous or vinous, may aſcend before the phlegm.*
3. *Whether ſpirit of human blood be really any thing but the volatile ſalt and phlegm well commixed.*
4. *The ſpecies of ſaline bodies, to which ſpirit of human blood is to be referr'd.*
5. *Whether ſpirit of human blood differs from ſpirit of urine, and other ſpirits that are called volatile alkalies.*
6. *The quantity of ſpirit contained in human blood; whether accompanied with its ſerum, or dried.*
7. *The ſpecific gravity of ſpirit of human blood.*
8. *The odour, taſt, colour, tranſparency, and conſiſtence of the ſpirit of human blood.*
9. *The ſolutive power of the ſpirit of human blood.*
10. *The tinctures that may be drawn with ſpirit of human blood.*
11. *The coagulating power of the ſpirit of human blood.*
12. *The precipitating power of the ſpirit of human blood.*

13. *The*

MEDICINE.

13. *The affinity between ſpirit of human blood, and ſome chymical oils and vinous ſpirits.*
14. *The relation between ſpirit of human blood and the air.*
15. *The hoſtility of ſpirit of human blood with acids, whether in the form of liquors, or of fumes.*
16. *The medicinal virtues of ſpirit of human blood, outwardly applied.*
17. *The medicinal virtues of ſpirit of human blood, inwardly uſed, in pleuriſies, head-achs, coughs, fevers, the ſcurvy, cachexies, dropſies, fits of the mother,* &c.
18. *Particulars omitted, and promiſcuous experiments, and obſervations, concerning the ſpirit of human blood.*

The ſeveral ways of diſtilling human blood.

Obſerving that ſeveral bodies, when diſtill'd, with quick-lime, afford liquors different from thoſe they would have yielded, if they had been diſtill'd either *per ſe*, or with ſome vulgar addition, we took five ounces of concreted, but not dry'd human blood, and having mixed it with an equal weight of quick-lime, we diſtill'd it, by degrees of fire, in a retort plac'd in ſand, and thereby obtain'd a large proportion of a reddiſh ſpirituous liquor, not conſiderably phlegmy, together with ſome oil, very ſmall in quantity; the reſt being probably kept back by the lime: and of this little oil, there was a ſmall portion that ſunk in the ſpirit; the reſt ſwimming upon it.

The ſpirit, being put into a ſmall head and body, was ſet in a digeſtive furnace to rectify, at leiſure, with a very gentle heat, and the receiver was three or four times ſhifted, that we might obſerve what difference there would be betwixt the ſucceſſive portions of liquor. The firſt that came over, did not ſmell near ſo rank as that diſtill'd *per ſe*. This obſervation belongs, alſo, to the three or four ſucceeding portions of liquor: probably, becauſe the lime had better freed the ſpirit of the firſt diſtillation from the fetid oil; many of whoſe particles are apt imperceptibly to mix with it, when drawn over without addition. The rectified ſpirit, which was clear and colourleſs, had a taſt much ſtronger than its ſmell; for a ſmall drop of it upon the tongue, had ſomething of a firyneſs that was ſurprizing, and laſted longer than one would wiſh; which made me doubt, whether the ſpirituous part of the blood had not carried up with it, ſome of the firy parts of the quick-lime: whence one wou'd expect ſome uncommon effects from ſuch a ſpirit, which, in this caſe, would be enriched with a kind of volatalized alkali; a thing much deſired by many chymiſts and phyſicians. Upon this ſuſpicion, we dropt a little of it into a ſtrong ſolution of ſublimate, in fair water, when it ſeem'd, at the firſt contact, to make a precipitate a little enclining to yellow; tho' afterwards the precipitate appeared white, like that made with ordinary volatile liquors of an urinous nature.

But expecting that our alkaline ſpirit of blood, ſo I call it, would have ſome peculiar qualities, differing from the ſpirit, drawn without ad-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE. the retort into a ſand furnace; and diſtilling by degrees of fire, we had a ſpirit which was preceded by a pretty deal of phlegmy liquor, of an odd ſulphureous ſmell, but ſurprizingly ſtrong and laſting. It ſeemed remarkable, that, notwithſtanding the great acidity of oil of vitriol, and the fixing power it exerciſes on many bodies, wherewith it is committed to diſtillation, our experiment affoided us a conſiderable quantity of volatile matter, in the form of a white ſalt; but the ſmell and taſt of it were very uncommon.

Whether human blood may afford, by diſtillation, a ſpirit, urinous or vinous, before the phlegm.

By what I have yet tried, I am not much encouraged to expect a vinous, or ardent ſpirit from human blood, tho' that be the uſual product of fermentation in liquors; and the leſs, becauſe I am not ſure that there is any fermentation, truly and properly ſo called, in human blood, either within or out of the body; having never found any rhino in the blood or urine, which convinced me, that either of them would afford an ardent ſpirit.

I once kept human blood for a year together, in a glaſs, hermetically cloſed, with a deſign to try, whether any ſpirits would firſt aſcend; but when the blood came to be expoſed to the air, the ſcent of it was ſo offenſive, that we were obliged to have it haſtily thrown away. Another time, having cauſed ſome ſheeps blood to be digeſted, in a large vial hermetically ſealed; after it had long continued in the digeſtive furnace, it, upon a ſudden, broke with a ſurprizing noiſe, and blew off the long neck of the vial. Two or three like miſchances I had, in attempts made on human blood. But this ill ſucceſs did not hinder me from attempting ſomething of the like kind; and looking upon the ſerum of the blood, as the likelieſt part of it to concur to a proper fermentation, we put to ſome ounces of it, about a fourth part of raiſins well bruiſed, and kept them in a glaſs, whereof a conſiderable part was left empty; and having cloſed the veſſel, we ſet it in a warm room; and within a few days the raiſins began to emerge, and afterwards continued to float; and there was produced a conſiderable quantity of parmanent and ſpringy air. Which phenomena ſeemed plainly to argue, that there had been ſome degree of fermentation produced in the mixture; yet when we came to diſtil the ſerum, thus alter'd, tho' it did not ſmell as if it had putrefied, yet the liquor that firſt aſcended, even with a gentle heat, did not taſt or ſmell like a vinous ſpirit; tho' it differed from meer phlegm. I, likewiſe, tried, with the ſerous part of the blood, whether it would by digeſtion, or putrefaction, be ſo opened, as, when diſtill'd, to let the ſpirit aſcend before the phlegm; and having kept a quantity of this ſerum above four times as long as is ſufficient to make urine, in diſtillation, part with its ſpirit before its phlegm, we diſtill'd it with a very gentle fire, that few or none beſides the fugitive parts, might at firſt aſcend. But we found the liquor that came over, to have but little ſtrength, either as to ſmell or taſt; nor did it readily turn ſyrup of violets green, tho' after ſome hours ſtanding together,

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it would; yet as a volatile alkali, it presently turned a strong solution, made of common sublimate in fair water, into a white, opake, and almost milky liquor.

Whether spirit of human blood be any thing but the volatile salt and phlegm united.

What has hitherto occurred to me, inclines me to think, that the spirit of human blood is totally compos'd of volatile salt and phlegm, tho' not, perhaps, pure and unmixed; for when the spirit, volatile salt, and oil, are separated from it by distillation and sublimation, as far as is usual in chymical preparations of volatile alkalies, the remaining liquor, which passes for phlegm, will yet be impregnated with some particles of oil, and sometimes a few of volatile salt, that are too minute to be distinguishable by the naked eye. But whether frequent rectifications may so accurately separate these heterogeneous parts, as perfectly to free the aqueous ones from them, and thereby reduce the phlegm to simple, or elementary water, I leave undetermined. And the rather, because, by frequent distillations, some particles of the fire may, possibly, from time to time, substantially be associated with those of the liquor; and even in the first distillation of human blood, the fire may have either separated, or produced a liquor, that, tho' almost strengthless, and not justly referable to any of the received principles, or ingredients, oil, salt, and earth, is not yet phlegm, truly so call'd, but a neutral liquor, which woods, and many other bodies, afford by distillation, that is neither acid, nor alkalizate, nor true phlegm.

But as a composition may be discovered, perhaps better by producing, than by resolving it; we dissolved in distill'd water as much volatile salt of human blood, as the liquor would take up; and then having carefully distilled it in a conveniently shaped vessel, with a regulated degree of heat, the distillation afforded us a liquor, that, by its smell, taste, and operations, appeared to be a good brisk spirit of human blood. And this experiment was repeated with the like success.

The species of saline bodies, to which this spirit is referable.

'Tis well known, that of late, saline spirits obtained by distillation, have been observed to be of two sorts; the saline spirits that ascend in distillation, are some of them acid in taste; as spirit of nitre, spirit of vitriol, *&c.* and some have tastes like common salt, or like lixiviate salts; but their difference is greater in their operations than their tastes; for being put together, there will presently ensue a manifest conflict between them, and usually the one will precipitate the bodies that the other hath dissolved. 'Tis necessary to add, that among the salts called alkalies, some are fix'd in considerable degrees of fire, and others are not; for which reason many modern chymists and physicians, who take acid and alkali for the true principles of mix'd bodies, call the one fix'd, and the other volatile alkalies. And since the names fix'd alkalies, and volatile, are now much in request, I shall sometimes use them in the vulgar acceptation.

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This being premis'd, I ſay, the ſpirit of human blood is to be referred to that ſpecies of ſaline bodies; becauſe tho' the ſpirit of blood be a liquor, yet its more efficacious operations ſeem totally to depend upon the fugitive ſalt wherewith it abounds. We know, that ſome volatile ſalts, which riſe even in a dry form, may not be of an alkalizate, but acid nature; and not only *Helmont* and his diſciples, but a great part of the modern chymiſts and phyſicians, alſo, aſcribe digeſtion to an acid ferment, or menſtruum in the ſtomach; whence it ſhould ſeem, that acid corpuſcles may paſs into the maſs of blood, and impregnate it. But notwithſtanding this, the ſpirit of human blood is manifeſtly referable to that claſs, which many call volatile alkalies (and I often term urinous ſpirits); for I find ſpirit of blood capable of effecting thoſe things, the performance of which has been look'd on, almoſt ever ſince I propoſed them, as the touch-ſtone to know volatile alkalies, and diſtinguiſh them from the other ſorts of ſaline bodies; for it will make a great conflict with acid ſpirits, as ſpirit of ſalt, *Aqua fortis*, &c. it immediately turns ſyrup of violets into a fair green; 'twill precipitate a ſolution of ſublimate, in common water, into a white powder; and, in ſhort, produce thoſe other effects that may be expected from true volatile alkalies.

If, indeed, I were ſure, digeſtion was performed by an acid ferment or juice, whenceſoever the ſtomach is furniſh'd with it, I ſhould ſuſpect that ſome acid particles may be mixed with the blood. But that would not hinder me from referring the ſpirit of human blood to volatile alkalies; becauſe ſo few acid particles would be either deſtroy'd by the alkalizate ones, that ſo abound in the ſpirit; or at leaſt theſe would be ſo very predominant, as might well allow us to give their denomination to the mixture. Thus, if a few drops of ſpirit of vinegar were mixed with ſome pints of ſtale urine, they would either be deprived of their acidity, by ſome corpuſcles of a contrary nature, that they meet with in the liquor; or be ſo obſcured and overpowered by the fugitive ſalts it abounds with, that the acid particles would not hinder the ſpirituous liquor, drawn from the mixture by diſtillation, to be juſtly referable to the claſs of volatile urinous ſalts.

Whether it differs from ſpirit of urine, and other volatile alkalies.

It ſeems hard to determine, whether there be any difference betwixt the ſpirit of human blood, and other volatile alkalies; becauſe two bodies may agree in many qualities, and, perhaps, in all the moſt obvious; and yet on ſome third body, or in ſome caſes, manifeſt diſtinct powers, and have their peculiar operations.

But there may be a great difference between volatile ſalts and ſpirits, as they are ordinarily prepared for medicinal uſes, and as by repeated rectifications, and other ways of depuration, they may be brought to a greater ſimplicity or purity. And whether the ſpirit of human blood, and other liquors abounding, like it, in volatile alkalies, reduced to as great a purity, as they can, by art, be brought to, would be altogether alike in their nature and qualities, or no; yet,

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The conſiſtence and ſpecific gravity of the ſpirit of human blood.

I found that a compact body weighing fifty-eight grains, in the air, and in water ſix grains, and three fourths, weighed in rectified ſpirit of human blood but five grains, and one fourth. And notwithſtanding the volatility of our ſpirit of blood, I found that a large piece of amber, being put into it, did not fall to the bottom of the liquor, but kept floating at the upper part of it; and if plung'd into it, would emerge.

One might expect a manifeſt degree of tenacity in the ſpirit of human blood, becauſe, among many modern chymiſts, it paſſes for an alkali; and we know that ſeveral other alkalizate liquors, as oil of tartar *per deliquium*, fixed nitre reſolved the ſame way, ſolution of potaſhes, *&c.* are ſenſibly unctuous, and but languidly fluid; yet I did not obſerve, that ſome rectified ſpirit of human blood, tried between my fingers, did feel more unctuous than common water. And as thoſe who ſell brandy, or ſpirit of wine, uſually ſhake it, till it afford ſome froth, and then by the ſtay this makes on the ſurface, judge of the tenacity or tenuity of the liquor; eſteeming that to be the moſt unctuous, whereon the bubbles make the longeſt ſtay, and *è contrà*; I thought fit, by the ſame method, to examine ſpirit of human blood; and found, that the froth would laſt very little on the ſurface of it; the bubbles breaking or vaniſhing, almoſt as ſuddenly as if the liquor had been good ſpirit of wine. I, likewiſe, obſerved, that when I warily let fall of our well rectified ſpirit of blood upon ſome other body, it ſeemed that the ſingle drops were manifeſtly ſmaller than thoſe of water, and of ſeveral other liquors, would have been.

Its ſubtility and activity.

Becauſe it may be of ſome importance, to know how ſubtile the active parts of ſpirit of human blood are, and how diſpoſed or fitted to diſperſe or diffuſe themſelves through other liquors of convenient textures; we ſo prepared common water by infuſions, made in it without heat, that by putting one ſingle drop of our rectified ſpirit of human blood into four ounces, and four ſcruples of the prepared water, and lightly ſhaking the vial, there appeared through the liquor a manifeſt colour, whereof no degree at all was diſcernible in it juſt before: which ſufficiently argues a wonderful ſubtilty of parts in the ſpirit we employ'd; ſince a ſingle drop of it could diſperſe its corpuſcles through, and unite with two thouſand times as much water; and yet retain ſo much activity, as to make their preſence not only ſenſible, but conſpicuous, by a manifeſt change of colour which they produced. This computation, indeed, is made, upon ſuppoſition, that a drop of water weighs about a grain, and that a drop of our ſpirit of blood was of the ſame weight with a drop of water.

The former ſuppoſition is commonly made; and tho' I have not found it to be exactly true; (for a drop of water weighs more than a grain;) yet this difference is much more than recompenſed by that we found between the weight of a drop of water, and the weight of one of ſpirit of human blood. For having, in a very good balance, let

fall ten drops of common water, and as many of our rectified ſpirit of human blood, we found, as we might well expect, that a drop of the ſpirit, as it was manifeſtly leſs, ſo it was far lighter than a drop of water; whence the whole ten drops did not amount to four grains; ſo that we may ſafely judge the drop of ſpirit to have manifeſtly diffuſed it ſelf, and acted upon above four thouſand times ſo much water in weight, (and perhaps in bulk too;) ſince, indeed, the proportion extended a conſiderable way towards that of one to five thouſand; and may, therefore, be ſaid to be as that of one to between four and five thouſand. And yet a conſiderable part of the ſingle drop I employed was phlegm, uſeleſs to the change produced; the effect being wholly due to the ſaline ſpirit of the little ſingle drop. MEDICINE.

Its heat, and coldneſs.

The ſpirit of human blood is, with regard to ſome liquors, potentially cold, ſince it refrigerates them; and in reference to others, potentially hot; ſince being mix'd with them, the mixture becomes actually hot.

Into a ſlender cylindrical glaſs we put the lower part of an hermetically ſealed thermometer, and into the ſame glaſs poured as much moderately ſtrong ſpirit of blood, as would cover the ball of the thermometer; when, dropping on this liquor ſome good ſpirit of ſalt, there was produced a conflict, accompanied with noiſe, bubbles, and a heat, that ſuddenly made the ſpirit of wine aſcend above two inches and a half. This experiment is the more conſiderable, becauſe there are many volatile alkalies that, being confounded with acid ſpirits, tho' they ſeem to make a true efferveſcence, yet really produce a notable degree of coldneſs. And tho' I have, ſeveral times, found, that the ſpirit of verdigreaſe would, with volatile ſalt of ſal-armoniac, or of urine, produce a ſeeming efferveſcence, but a real coldneſs; this ſpirit of verdigreaſe, being mix'd in the foreſaid ſmall cylindrical glaſs, with but moderately ſtrong ſpirit of blood, did not only produce a hiſſing noiſe, and numerous bubbles, but an actual heat, whereby the ſpirit of wine in the thermometer was made quickly to aſcend above an inch and a half; tho' the liquors employed amounted not, both together, to two ſpoonfuls.

Having into a wide-mouth'd glaſs put as much ſpirit of blood, as would more than cover the ball of a ſmall ſeal'd weather-glaſs, and ſuffered this inſtrument to ſtay there a while, that the ambient liquor and the included might be reduced to the ſame temper, as to heat and cold; we poured on ſome ſpirit of verdigreaſe made *per ſe*, and obſerved, that tho' this ſpirit, with ſome other volatile ſaline liquors, had a very differing operation, yet working with our ſpirit of blood, with which it made a conflict and excited bubbles, there was produced in the mixture a degree of warmth, ſenſible on the outſide of the glaſs; but it was much more ſenſible in the thermometer, the liquor whereof aſcended to a conſiderable height above the former ſtation, to-

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towards which, when the conflict of the two liquors was over, it began, tho' ſlowly, to return.

Since ſeveral ſalts, both volatile and fixed, being powder'd and put into water, will, whilſt they are diſſolving, ſenſibly refrigorate it; and on the other ſide, ſince ſome very ſubtile ſpirit, actually cold, being put into cold water, will quickly produce in it a ſenſible warmth, I thought proper to try, what the ſpirit of human blood would do, when employ'd after the ſame manner. Having, therefore, placed a ſealed thermometer in an open-mouth'd glaſs, furniſh'd with as much diſtill'd water as would cover the ball of the inſtrument, we left it there for a while, to bring the internal liquor and the external to the ſame degree of coldneſs: then we poured upon the immerſed ball two or three ſpoonfuls of ſpirit of human blood, but perceived no alteration in the thermometer, unleſs the ſpirit of wine in the ſtem ſubſided a very little.

Its ſolutive power, and balſamic virtue.

We took crude copper, in filings, and having poured on it ſome highly rectified ſpirit of human blood, we ſhook them together, and in about a quarter of an hour, or leſs, perceived the menſtruum to look a little bluiſh; and this colour grew gradually higher, till after ſome hours the menſtruum had diſſolved copper enough to make it deeply blue. In ſome circumſtances the ſpirit of blood has a ſurprizingly ſudden operation upon copper. For having made a coined piece of that metal clean and bright, and put a drop or two of our ſpirit upon it; within about half a minute, the verge of the moiſtened part of the ſurface appeared bluiſh, and preſently after, the reſt of the wetted part acquired a fine azure colour.

We alſo took filings of zink, or ſpelter, and having poured on them very well rectified ſpirit of blood, we obſerved, that, even in the cold, it quickly began to work manifeſtly, tho' not vigorouſly thereon. But being aſſiſted with a little heat, it diſſolved the zink briſkly, and not without producing numerous bubbles.

I took a piece of coagulated blood, but not dry'd, ſomewhat bigger than a large pea, and cut from the lower part of the lump, that it might be black. This clot we put into a ſlender vial of clear glaſs, that the colour might the better be diſcerned, and then poured upon it a little rectified ſpirit of human blood, and ſhook the glaſs a little; whereupon the colour of, at leaſt, the ſuperficial part of the blood, was, in an inſtant, manifeſtly changed; the blackneſs quite diſappearing, and being ſucceeded by a very florid colour, like that of fine ſcarlet. The liquor, alſo, was tinged, but not with near ſo deep or ſo fair a red; and by the little bubbles, which, from time to time, paſt out of the clot, it ſeemed to work ſomewhat like a menſtruum. Yet ſoon after, coming to look upon this lump of blood again, I found it to have much degenerated from its natural colour, to one leſs fair and more dark.

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the ſolutions made of both parcels, were of a deeper and more lovely blue, than the mineral it ſelf. Nor did I obſerve in them any precipitate of a dark colour, as I have done upon the mixture of ſpirit of urine, and ordinary vitriol.

On freſh filings of iron, we poured ſome of our ſpirit, and having kept them a while together in digeſtion, we found that the liquor had wrought on the metal, and produced a conſiderable quantity of a light ſubſtance, in colour almoſt like the *Crocus*, but ſomething paler. There alſo appeared in the liquor many thin plates, like a kind of *Terra foliata*, which after a very ſlight agitation, being held againſt the ſun-beams, exhibited the colours of the rain-bow, in a very vivid and ſurprizing manner: but I did not perceive that the taſt of the liquor was conſiderable ferruginous.

Having with a clean pen drawn ſome letters upon white paper, with ſpirit of human blood, and, as 'twas dry, mov'd the unwritten ſide over the flame of a candle; we found that this liquor may be employ'd as an inviſible ink; and it ſeemed to be ſomewhat better than thoſe afforded by ſerum and urine.

What tinctures may be drawn with ſpirit of human blood.

Spirit of blood being put upon *Engliſh* ſaffron, ſoon acquired a fine yellow colour.

The ſame put upon powder'd turmeric, did, in the cold, extract from it a lovely tincture, like a rich ſolution of gold; which, probably, may prove a good deobſtruent medicine, particularly in the jaundice.

Upon fine powder of human blood, we put ſome moderately ſtrong ſpirit of the ſame ſubject, on which the liquor began very ſoon to colour it ſelf, even in the cold; and within no long time after, appeared as red as ordinary *French* claret. This extract made me ſuſpect, that the phlegm which was not carefully ſeparated from the ſpirit I then employed, might haſten the colouration of the menſtruum. For which reaſon, I put upon another portion of the ſame powder, ſome rectified ſpirit of blood, ſo well dephlgmed, that it would not diſſolve a grain of the volatile ſalt of blood; and found that this menſtruum did not any thing near ſo ſoon draw a tincture, as the other had done; for after ſeveral hours, the colour it had obtained was but brown; tho', after ſome hours more, the colour appeared to be heighten'd into a redneſs; yet manifeſtly inferior to that of the phlegmy ſpirit, whereto it did, however, in a longer time, grow almoſt equal. By this means we may not only diſguize the ſpirit of blood, but impregnate it with the finer parts of the unanalyzed ſolid body, which may, poſſibly, make the ſpirit a remedy more proper for ſome diſeaſes, or conſtitutions: and this medicine I ſometimes call the entire tincture of human blood.

But to ſhew that the ſpirit of human blood may extract tinctures out of ſome of the hardeſt bodies, I made the following experiment.

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We took ſome choice filings of ſteel, and having put them into a ſmall glaſs-egg, we poured on them ſome highly rectified ſpirit of blood, and kept them all night in digeſtion with a moderate heat. The next day we found the menſtruum turn'd of a deep browniſh red colour; and ſome of the filings, that chanced to ſtick to the ſides of the glaſs, ſeemed to have been, either by exhalations from the menſtruum, or, perhaps, by the tranſient contact of it, as it was pouring in, turn'd into a kind of yellow *Crocus martis*. Having kept the menſtruum and the filings together, in the ſame egg, for ſome days longer, the colour was grown opake, and appeared to be black, when viewed in any conſiderable bulk: but it had another appearance, when thin ſpread upon white paper.

Suſpecting that our ſpirit would work upon ſteel, in another manner than common acid ſolvents, we poured ſome of the tincture, drawn from filings of ſteel, upon a freſh tincture of galls in common water, but did not find that this liquor would, with the infuſion, make any inky mixture; nor that the precipitate, which was quickly produced, was of a black, much leſs of a true inky colour.

I put ſome ſpirit of human blood upon fine powder'd amber, and kept them in digeſtion for ſome days, giving a moderate degree of heat; but we obtained not any conſiderable tincture: perhaps the ſpirit was not yet highly enough rectified, or the amber not ſo proper to yield its tincture, as I have ſeveral times found the courſer and deeper coloured ſort to be.

Having put ſome ſpirit of human blood upon ſeed-lac, tho' this be a reſinous gum, and of no eaſy ſolution, the ſpirit ſoon became tinged, as I expected, becauſe I conjectured, that the redneſs apparent in many of theſe grains, is but ſuperficial, and proceeds from ſome adhering blood of the little inſects, that by their biting occaſion the production of this gum, upon the twigs of the tree where the lac is found. So that the tincture ſeems not to be drawn from the lac it ſelf, but rather to be afforded from the blood of theſe little animals, which the ſpirit of human blood, that will draw tinctures from dry'd man's blood, diſſolves: and this tincture may, probably, be a good medicine; ſince moſt of the inſects uſed in phyſic, as millepedes, bees, *&c.* even in our colder climates, afforded remedies of very ſubtile and piercing parts, and of conſiderable efficacy.

The coagulating power of it.

I have found, by trial purpoſely made, that the highly rectified ſpirit of human blood, being well mixed, by ſhaking, with at leaſt an equal part of vinous ſpirits, which wou'd burn all away, there will preſently enſue a coagulation or concretion, either of the whole mixture, or a great portion of it, into corpuſcles of a ſaline form, that cohering looſely together, make up a conſiſtent maſs, tho' very ſoft: and in this form it may remain, as far as I have yet try'd, for, perhaps, ſeveral months, or weeks at leaſt, if it be kept in a cool place.

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In a froſty ſeaſon we expoſed late at night, two or three ſpoonfull of ſpirit of human blood, being but moderately ſtrong; and tho' the cold of that ſeaſon had throughly frozen a vial almoſt full of oil of vitriol; and the night wherein our ſpirit was expoſed, was moderately froſty, yet the next morning we did not find ſo much as any ſuperficial ice upon it: but having removed the vial into a mixture of powder'd ice, and common ſalt, we found, in no very long time, that moſt part of the ſpirit was turned into thin plates of ice, which join'd cloſe together, and had their edges upwards, like thoſe of the leaves of a book, when held with its back downwards.

Its precipitating power.

Of the precipitating power of ſpirit of human blood, I have yet obſerved nothing peculiar; but, as far as I have had occaſion to try, it has; in common with thoſe other volatile ſpirits which I call urinous, a power of precipitating moſt bodies that are diſſolved in acid menſtruums.

I have made trial upon red-lead, diſſolved in the acid ſalt of vinegar, ſilver in *Aqua fortis*, gold in *Aqua regia*, and tin in an appropriated menſtruum. I, alſo, with our ſpirit, precipitated the ſolutions of ſeveral other bodies, and, particularly, out of a ſolution of common ſalt, made in common water, we could readily precipitate with the ſpirit of blood, a ſubſtance that looked like a white earth: and ſuch a ſubſtance I obtained, in far greater quantity, from that which the ſalt-makers call bittern; which uſually remains in their ſalt-pans, after they have taken out as much as would coagulate in figured grains.

The ſpirit of human blood in part precipitates *Dantzick* vitriol diſſolv'd in water.

We attempted to make *Aurum fulminans*, by precipitating a ſolution of gold, made in *Aqua regia*, with ſpirit of human blood; by dulcifying the precipitate with common water, and then drying it leiſurely; and ſucceeded in the attempt.

The affinity between ſpirit of human blood, ſome chymical oils, and vinous ſpirits.

There ſeems, in the popular ſenſe of the word, to be an affinity between rectified ſpirit of human blood, and pure ſpirit of wine; ſince we have obſerved, that, being put together, they will readily coagulate, and continue united for a long time. And, it is very probable, that the like aſſociation may be, alſo, made with other ardent ſpirits, prepared by fermentation.

We have, likewiſe, formerly noted, that our ſpirit will make a ſolution of the finer parts of human blood well dry'd; which ſeems to be the effect of ſome affinity or congruity between the ſpirit and the body it works on; becauſe a highly rectified vinous ſpirit would not, that I could ſee, draw any tincture from it.

With lixiviate liquors, ſuch as are made of ſalt of tartar, fixed nitre, &c. reſolv'd in the air, or otherwiſe, the chymiſts will expect, that the ſpirit of blood ſhould have an affinity; ſince they eſteem all theſe liquors alkalies; tho' this be volatile, and thoſe be fixed. But tho' theſe liquors comport well with one another, yet we find not

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ſhaken theſe liquors together, to mix them very well, we plac'd the glaſs, in a fit poſture, in a furnace where it ſhould not have too great a heat; by which means the ſlight texture of the coagulum being diſſolved, part of the oil appeared by it ſelf, floating at the top of the ſpirit; whence, being ſeparated, the remaining liquor was whitiſh and without any ill ſcent; the ſmell predominant in it being that of the aniſeeds, of which it taſted ſtrongly; tho' the ſaline ſpirituous parts of the blood in this liquor retain'd a conſiderable degree of their briſk and piercing taſt.

The other way we uſed to aromatize our ſpirit of blood, was, by employing a medium, to unite it with eſſential oils. For which purpoſe, in a vinous ſpirit, ſo dephlegmed, that in a ſilver ſpoon it would totally burn away, we diſſolved, by ſhaking, a convenient proportion of an eſſential oil; and to this ſolution added a convenient quantity of our rectified ſpirit of blood; and having, by ſhaking, mixed them as well as we could, we ſuffered the expected coagulum to reſt for ſome time; after which it appeared, that ſome of the oil was revived, and ſwam in drops diſtinct from the other liquor, which conſiſted of a mixture of the two ſpirits, impregnated with the particles of the oil they had intercepted and detained. This liquor abounded with little concretions, made by the coagulation of the ſanguineous and vinous ſpirit. And theſe, with a very gentle heat, ſublimed in the form of a volatile ſalt, to the upper part of the glaſs; which ſalt ſeemed to have a leſs penetrating odour, than the meer volatile ſalt of human blood; but had quite loſt its ill ſmell, as had, alſo, the remaining liquor; both being moderately imbued with that of the oil.

I thought it worth trying, whether there was any affinity between our ſpirit and the highly rectified oil of petroleum; and having ſhaken together a convenient quantity of each, in a new vial, they preſently turn'd into a white mixture. And tho', after it had, for many hours, been left to ſettle, the greater part of the oil ſwam above the ſpirit; yet there appeared, betwixt the two liquors, a large quantity of a whitiſh matter, which ſeem'd to be produced by the precipitation or union of many particles of the ſpirit and oil, more diſpoſed than the reſt to combine with one another.

The relation between ſpirit of human blood and the air.

'Tis known that the contact of the air has a manifeſt operation upon extravaſated blood, by changing its colour from black to a florid red, in that ſurface which is expoſed to it. We thinly ſpread, upon a piece of white paper, ſome ſmall filings of copper, and wetted them well, without covering them quite over, with a few drops of good ſpirit of blood; by which means, being very much expoſed to the free air, the action of the liquor was ſo much promoted, that within a minute or two it did, even in the cold, begin to acquire a bluiſh colour; and ſooner than one would have expected, that colour was ſo heightned as to become blue. But when I put another parcel of the ſame filings into a vial, and covered them with ſpirit of blood, and then ſtopt

ſtopt the vial; to keep it from the external air, the liquor would not, in ſome hours, acquire ſo deep a colour.

Having, in a clear cylindrical vial, about an inch in diameter, put more filings of copper than were requiſite to cover the bottom, we poured upon them ſo much ſpirit of human blood, as ſerv'd to ſwim a finger's breadth above them. This liquor, becauſe of the quantity of air, contain'd in the vial, did, within few hours, acquire a rich blue colour, which, after a day or two, began to grow more faint, and continued to do ſo gradually till it almoſt vaniſhed; yet the liquor was not altogether limpid, or colourleſs, as I have often had it with ſpirit of urine, or of ſal-armoniac; which remains of bluiſhneſs I attribute to the great quantity of air, included in the vial, with ſo ſmall a quantity of liquor. And tho' I thought it poſſible, that length of time might deſtroy theſe remains of bluiſhneſs alſo, yet, without waiting for that, I unſtopt the vial, and perceived, in about two minutes, the ſurface of the liquor, where it was touch'd by the freſh air, became blue; and perhaps in leſs than a quarter of an hour, the whole body of the liquor had attained a deeper colour than that of the ſky; which colour, the vial being ſeaſonable and carefully ſtopt, began in two or three days to grow paler again.

Into a ſlender cylindrical vial we put filings of copper, more than enough to cover the bottom, and then pouring on ſome ſpirit of human blood, till it reach'd about an inch above the filings, we ſtopt the glaſs cloſe; and, as we expected, the menſtruum diſſolved ſome of the metal, and acquired upon it a deep blue colour, which, by keeping the veſſel in a quiet place, for ſome days, by degrees diſappeared, and left the liquor like water. And then the glaſs being unſtopt, there appeared a fine blue ſurface between the confines of the air and the liquor, in a minute or leſs; and this fine colour, extending it ſelf downwards, was, in no long time, diffuſed through the whole body of the liquor; and that ſo plentifully, as to render it almoſt opake. But tho' I kept the glaſs, for many days after, well ſtopt, yet the colour did not diſappear, as was expected, but continued very intenſe.

And having poured ſome of our ſpirit upon well-powdered *Lap. Armenus*, the liquor did, even in the cold, and in no long time, acquire a deep and lovely blue, almoſt like the ſolution of filings of crude copper, made with the ſame menſtruum.

I alſo made the like experiments ſucceed, with other ſpirits abounding in volatile ſalts; and, indeed, I found, by a careful tryal, that by means of a volatile ſpirit, made without any ſubſtance afforded from the body of man, I could, with filings of copper, make an experiment very like the preceeding; tho' in this the repeated contact of the air produc'd in the liquor not a blue, but a green colour.

Spirit of vinegar being put upon the florid ſuperficies of a parcel of human blood, very quickly deprived it of its freſh ſcarlet colour; and made it of a dark or dirty one.

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The juice of a lemmon ſqueezed upon the florid ſurface of blood, preſently impair'd the colour; but did not appear to alter it any thing near ſo much as the ſpirit of vinegar.

Juice of oranges chang'd the colour of the florid ſurface of blood, leſs than juice of lemmons.

The black or lower part of a portion of human blood, being turn'd uppermoſt, and thereby expoſed to the air, within three quarters of an hour, acquired by the contact of it, a pleaſant and florid colour.

But if upon the black ſurface of the blood ſome good urinous ſpirit were dropt, an alteration would immediately be made; and a pleaſant red colour preſently appear on the ſurface of the blood.

Fixt alkalies, or lixiviate ſalts, reſolv'd *per deliquium*, likewiſe alter'd the black ſuperficies of the blood to a red colour; but not ſo florid or pleaſant as that produc'd by the urinous ſpirit. The freſh juice of the leaves of ſcurvy-graſs being drop'd upon the black ſuperficies of a lump of human blood, ſeem'd preſently to make ſome change in the colour of it, which we judg'd to be ſomewhat reddiſh, inclinable to florid.

Having, in an unſtopt glaſs, put ſome ſpirit of human blood into a receiver, placed upon our pneumatic engine, and withdrawn the incumbent air by pumping; the ſpirit of blood ſeem'd to afford leſs and fewer aerial bubbles, than ſuch a quantity of common water it ſelf would, probably, have done.

Having unexpectedly found a vial, that was written upon above twelve years before, and inſcribed ſpirit of human blood, it appear'd to have been very looſely ſtopt; yet not ſo, as to give cauſe to think the liquor was much waſted. But it had acquired a deep colour almoſt like that of red wine, and was ſo diſpirited and ſtrengthleſs, that it appeared to be very little other than nauſeous phlegm. Hence we may gueſs, how little a portion of the noble and genuine ſpirit, or ſalt, may ſuffice to make a liquor paſs for ſpirit of human blood.

The hoſtility of this ſpirit with acids, in the form of liquors and fumes.

That there is in the ſpirit of human blood ſuch a thing as a chymiſt, or a vulgar philoſopher, would call hoſtility, or an antipathy to acids, has been plainly intimated already. I now add, that our ſpirit exerciſes this hoſtility againſt more than one ſort of acid ſpirits; tho' perhaps they differ widely from one another; as ſpirit of ſalt, ſpirit of nitre, ſpirit and oil of vitriol, *Aqua fortis*, *Aqua regia*, &c. and even againſt natural acids too; as I found by the conflict it would make with freſh juice of lemmons, which it would put into a confuſed agitation, accompany'd with bubbles. And this was yet the more evident, when I employed the volatile ſalt of blood; that is, the ſpirit in a dry form: for having ſqueez'd upon a parcel of this, ſome juice of lemmons, there was preſently excited a great commotion, accompany'd not only with froth but noiſe. Nay, further, this hoſtility extends even to the inviſible effluvia of liquors, as appears by putting any ſtrong acid ſpirit, as of ſalt, or of nitre, &c. into a wide-mouth'd vial,

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having been kept for a year, was limpid and colourleſs, like an ordinary vegetable ſpirit.

Some of the fore-mentioned cryſtals being put upon well kindled charcoals, preſently melted, and burnt away with a noiſe like that of ſaltpetre; but the flame ſeemed not quite ſo flatulent, and differed in colour; being not at all blue, but very yellow. After the deflagration was quite over, I found an odd fixt ſubſtance left upon the coals; for it was not of a light colour, nor of an incoherent body like aſhes, but a little lump of a brittle, dirty-coloured matter, in which I could not perceive an alkalizate taſt, and, indeed, ſcarce any at all. And this ſubſtance being held in the flame, became red-hot, without appearing deſtroyed, no more than afterwards it did, by being long kept upon a glowing coal.

Having, by degrees, mixed our ſpirit of blood, with as much good ſpirit of nitre as it wou'd manifeſtly work on, there were, with noiſe, produced numerous bubbles; and being kept in a quiet place, till after the liquors had quite ceaſed to work on one another, it began to appear, that notwithſtanding all our care to free the ſpirit of blood from oil, ſomething oleaginous, that had been concealed in it, was partly ſeparated by this operation; ſince not only a reddiſh colour was produced by it, but after a while the ſurface of the liquor was covered with a film; ſuch as I have often obſerved in ſaline liquors greatly impregnated with antimony, or other ſulphureous bodies. And this thin membrane had its ſuperficies ſo diſpos'd, that looking upon it with the eye placed conveniently, it appear'd adorn'd with vivid colours of the rain-bow; and in the ſame order they are ſeen in the clouds.

The medicinal virtues of ſpirit of human blood, externally apply'd.

As far as I have obſerved, we do not regularly meet with any acid ſubſtance (unleſs we except the *Succus pancreaticus*) in a ſound human body; but the ſeveral parts of it, whether ſolid as bones, or liquid as blood, afford in diſtillation plenty of liquor, impregnated with volatile ſalt; whence I am induced to think, that the ſpirit of human blood, wherein ſuch a ſalt abounds, and whereof it is the principal and predominant ingredient, may, probably, have notable operations upon the human body, and afford medicines of great efficacy in many diſeaſes. And tho' againſt moſt of theſe it is to be internally given, yet there are ſome in which it may be ſucceſsful, when but externally adminiſtred. For, ſince well rectified ſpirit of human blood abounds with very ſubtile particles, which, in point of taſt, odour, diffuſiveneſs, and penetrancy, much reſemble thoſe of ſtrong ſpirits of urine, of hartſhorn, and of ſal-armoniac; we may, very probably, expect to find the ſame virtues in the ſpirit of blood, that experience has ſhewn belong to them.

I have ſcarce ever ſeen any medicine operate ſo ſuddenly in hyſteric fits, as a well dephlegmed ſpirit of ſal-armoniac; (which is, in effect, chiefly a ſpirit of urine; a liquor ſeparated from blood) and this by being barely applied to the noſtrils. And even in agonizing perſons, where it could not recover them, it wou'd frequently, for the time, bring

ring them out of their ſwoons, and make them know and underſtand the aſſiſtants, and, perhaps, ſpeak to them too; of which I could give inſtances. A patient of Dr. *Willis*'s, being in an apoplectic fit, was, by the Doctor at his going out of town, committed to the care of a very ingenious phyſician, who complain'd to me, that they could not hope for any ſucceſs of their remedies; ſhe being ſtupid, and having ſhut her mouth ſo cloſe, that they could not get any thing down; upon which I gave him a very ſubtile ſpirit, either of ſal-armoniac, or ſome other volatile and liquid alkali; by applying which to her noſe, the phyſician found he could preſently make her open her eyes, and, in part come to her ſelf; but then ſhe wou'd again, when the glaſs was removed, ſoon relapſe. But having by thoſe frequent viciſſitudes, gain'd ſome time, and got a medicine for his purpoſe, he then held the glaſs to her noſe long together; by which means ſhe ſo recover'd her ſenſes, that ſhe was prevail'd upon to take the medicine; and tho', afterwards, upon removal of the vial, ſhe returned into a ſenſleſs ſtate, yet by the help of the urinous ſpirit, they kept her alive, till the medicine ſhe had taken began to act, and make a large evacuation; which rouzed her, and, by degrees, relieved her. But in ſuch difficult and deſperate caſes, I am not content that a vial, with a long neck, be held to the noſe, but ſometimes order, that little pellets of lint, or cotton, be dipt into the ſpirit, and thruſt up the noſtrils; the ſame thing I would adviſe, if need ſhould require it, in the adminiſtration of ſpirit of human blood. And as, for external uſes, I make a particular preparation of ſpirit of ſal-armoniac, or of urine, that is more ſtrong and piercing than that prepared in the more ordinary way; ſo to improve our ſpirit of blood, we put to ſome dry'd volatile ſalt of human blood, as much ſpirit of nitre as wou'd juſt ſerve to ſatiate it; and then, by evaporation, obtained an anomalous kind of compound ſalt, which afterwards, becauſe we deſired a medicine in a dry form, we ſublimed from an equal weight of ſalt of tartar; a body fit to retain not only the phlegmy parts, but the oleaginous too, that often lie conceal'd in volatile ſalts and liquors, wherein they do not at firſt appear, and to which the greateſt part of their fetid or offenſive ſmell, may, probably, be imputed: by this means we obtained a dry white ſalt, of a very piercing ſcent. And to bring over the ſaline part of blood, in a liquid form, which, for the uſe of ſmelling, I commonly prefer to the dry; we mixed two parts of dry'd human blood, with three of lime, and then diſtill'd them with a ſtong fire; whereby we obtained much ſpirit, unaccompanied with any volatile ſalt in a dry form; which ſpirit ſeem'd, even without rectification, to have a ſtronger ſmell, and a more fiery taſt, than other ſpirit of blood, after rectification. And if we had taken more, or ſtronger lime, we ſhould, probably, haye had leſs oil, and a more piercing ſpirit; ſince the lime wou'd, probably, have retained moſt of the oil, and, perhaps, all the ſuperfluous moiſture.

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I have, likewiſe, often found, that ſlight head-aches have been cured in leſs than a quarter of an hour, by the bare ſmell of ſome of theſe well depurated volatile alkalies; and have been particularly relieved by that of human blood; very rarely, for theſe many years, uſing any other medicine, to free my ſelf from pains of the head. And even violent and durable pains of that part have been, if not quite removed, yet much leſſen'd by the ſame remedy often repeated; which I have, likewiſe, obſerved to be uſually very effectual in faintings, eſpecially thoſe of hyſterical women, and hypochondriacal men: whence our ſpirit of human blood, which is a liquor that in many qualities manifeſtly reſembles other volatile alkalies, and which, when well freed from its oil, can ſcarce be diſtinguiſh'd from other urinous ſpirits, may, by its odour, be available in the like diſtempers. But for the more delicate patients; the offenſive odour of our ſpirit may be greatly leſſened by long digeſtions, or by repeated, or ſkilful rectifications, with the addition of high rectified ſpirit of wine, or chymical oils. Thus, a very few drops of true oil of rhodium will, as I have tried, make an ounce of ſpirit of wine ſo fragrant, that this ſolution being ſhaken together with a convenient quantity of well rectified ſpirit of human blood, there will a mixture be made, that I found to have a briſk ſcent; and yet to be finely imbued with the odoriferous particles of the rhodium.

Thus, alſo, the high tincture of amber, taken with ſpirit of wine, may be employed to correct the odour, and increaſe the virtues of ſpirit of human blood. But becauſe it requires ſome ſkill, and much time, to draw this tincture from crude amber, tho' finely powder'd; I uſed the following quick and eaſy way, to draw a ſtrong tincture from the oil it ſelf: for tho' this oil will not, even by long ſhaking, throughly diſſolve in ſpirit of wine, yet I found, that by well ſhaking thoſe two liquors together, and leaving them to ſettle at leiſure, tho' they would ſeparate into diſtinct maſſes, yet the ſpirit of wine, even in the cold, extracted from the oil a fine tincture, of a high yellow colour, little different from that of the oil it ſelf. Of this tincture I afterwards mixed as much with ſpirit of blood, as ſufficed to obſcure the urinous ſmell, and make that of the oil of amber ſomewhat predominant; and, as we judged, more ſubtile and briſk than it was before.

But, beſides theſe medicinal uſes, that may be made of the odours of ſpirit of blood, ſimple or compounded, it may have conſiderable virtues, apply'd in ſubſtance as a liquor, by way of fomentation, or otherwiſe. Thus the ſpirit of ſal-armoniac has been much commended, for mitigating the ſharp pains of the gout; and is ſaid to have been ſucceſsfully us'd in the eryſipelas. And as our liquor is very ſpirituous and penetrating, and therefore proper to ſtrengthen and reſolve, and alſo of an alkalizate nature, which fits it to mortifie acidities; it ſeems very probable, that by vertue of theſe, and other benign qualities,

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MEDICINE. ſtanding the unfriendlineſs of the ſeaſon; ſo that about the end of *February*, ſhe grew able to venture for *Montpellier*; from whence, in autumn, ſhe return'd recover'd. The ſame ſpirit of blood, made very pure and ſubtile, by the help of a lamp-furnace, was the medicine I put into the hands of an ingenious and ſucceſsful phyſician, who complained to me, that a patient had quite puzzled him, and baffled the endeavours of other eminent men. This patient was frequently obnoxious to ſuch violent and tormenting fits of the head-ach, that he could not endure the light; and was offended with almoſt every noiſe or motion that reach'd his ears; whence he was forc'd to give over his profeſſion; but upon the conſtant uſe of the human ſpirit of human blood, he received ſuch relief as made him, with great joy, return to the exerciſe of his trade. And the phyſician, to whom I gave the remedy for him, told me, that the patient having, by our famous *Harvey*'s advice, been uſed to bleed once in two or three months, the phyſician counſelled him, tho' recovered, not abruptly to break off his ancient cuſtom; and the patient thereupon ſent for the ſame chirurgeon who had formerly let him blood; but when this chirurgeon, who knew not what had been done to the patient, came to open a vein again, and perceived what kind of blood it afforded, he was ſo ſurprized, that he ſtopt the operation, and aſk'd the man, with wonder, how he came by ſuch florid blood, who uſed to have it ſo bad; adding, that 'twas pity to deprive him of ſo well-condition'd a fluid.

The medicinal virtues hitherto mentioned, belong to the ſpirit of human blood, as 'tis pure and ſimple: but 'tis not improbable, that it may acquire other, and perhaps nobler faculties, if it be dexterouſly corrected, diverſified, or united with fit ingredients; that is, in a word, ſkilfully altered or compounded. Theſe things may be performed ſeveral ways: as, 1. By uniting, by long digeſtion, or frequent cohobations, the ſpirit of human blood, with the oils, ſalt, and phlegm of the ſame concrete, into a particular kind of mixture called *Clyſſus*. 2. By uniting the ſpirit of blood with acids, as with ſpirit of nitre, ſpirit of vinegar, *&c.* and employing theſe mixtures, either in their liquid form, or reduc'd, by evaporation, into cryſtals or other ſalts; and making uſe of theſe, either as they are, or after a kind of analyſis of them. 3. By uniting our ſpirit with metalline ſolutions, as of gold, ſilver, mercury; and with a ſolution of minium, made with ſpirit of vinegar, by the mixture of which liquor with ſpirit of blood, and a ſlow evaporation, I have had many finely figured cryſtals. 4. By diſſolving in ſpirit of blood, carefully dephlegmed, ſulphur open'd with ſalt of tartar: or by diſſolving in it ſome metalline bodies, as copper, zink, and iron; the latter whereof will afford a liquor, very different from other preparations of ſteel uſually made with acids; and may, probably, have ſome virtues diſtinct from thoſe of the known remedies made of that metal.

But,

But, at once to correct, diverſify, and compound our ſpirit, we may add to it, when we well rectified, an equal or double weight of rectified ſpirit of wine. For theſe liquors, being well ſhaken together, will, in great part, coagulate into ſalt, which, with a very gentle heat, will ſublime in a dry form, wherein I found it to have loſt almoſt all its offenſive ſmell. And tho', againſt this way of proceeding it may be objected, that the efficacy of the medicine is, as well as the urinous ſmell, much weakened; yet I found this ſalt to retain a conſiderable degree of quickneſs and penetrancy. And that which our compounded ſalt leaves behind, if it be dephlegmed, may afford no deſpicable liquor, both for medical and mechanical uſes.

And if the more ſimple way of altering the ſpirit of human blood be carried on a little further, by diſſolving in the ſpirit of wine, before the conjunction of the two ſpirits be made, a convenient proportion, as perhaps a twenty-fourth part of an eſſential chymical oil; the volatile ſalt ſublimed from this mixture, will not only be deprived of its ill ſmell, but endow'd with the ſcent and reliſh of the oil; which, by being thus united with a ſalt, very ſubtile and friendly to nature, will leſs over-power and offend the brain and ſtomach, than meer chymical oils; and being aſſociated with ſuch agile and penetrating corpuſcles, may, with them, gain admiſſion into the more inward receſſes of the body, and there exerciſe the virtues belonging to the vegetables that afforded the oils, or at leaſt to the oils themſelves. In this odoriferous aromatic mixture, the oleaginous particles are, by the intervention of the ſaline ones, brought to unite readily with other liquors, and even with aqueous vehicles, and to continue long enough mixed for the patient to take them commodiouſly. And thus there may be a multitude of *Salia volatilia oleoſa*, that is, of pleaſing, ſubtile, and efficacious remedies for inward uſes, prepared; even as many as the phyſician, or chymiſt, ſhall make eſſential oils. And if theſe be drawn from cephalic plants, as marjoram, roſemary, *&c.* or from cephalic ſpices, as nutmegs, cinnamon, *&c.* they will, probably, afford very briſk and grateful medicines, to relieve and comfort the brain and ſpirits, *&c.*

I recommend it to phyſicians to begin the natural hiſtories of the other animal fluids, as the *ſaliva*, *lympha*, pancreatic juice, *&c.* Only having beſtowed much pains upon urine; and thinking it a moſt noble ſubject to work upon; I ſhall here ſubjoin a ſet of titles, which I once drew up for the natural hiſtory of it.

Heads for the natural hiſtory of human urine emitted by healthy men.

1. *The colours of human urine.*
2. *Its taſt.*
3. *Its ſcent, freſh and putrified.*
4. *The heat and cold of human urine.*
5. *The ſpecific gravity of human urine.*
6. *The conſiſtence of it, as to denſity, viſcoſity,* &c.

7. *The*

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7. *The aerial particles contained in it.*
8. *Whether human urine is a fit liquor for fermentation, properly ſo called.*
9. *The difference between freſh and ſtale human urine.*
10. *The fermentation, or putrefaction, of human urine, and the time it requires.*
11. *The ſpontaneous ſeparation of parts in human urine.*
12. *Its vulgar analyſis, by diſtillation.*
13. *Some other ways of diſtilling human urine.*
14. *The proportion of the ingredients of human urine.*
15. *The ſpirits of human urine.*
16. *The phlegm.*
17. *The volatile ſalt.*
18. *The fixt ſalt.*
19. *The compound ſalt.*
20. *The ſhining ſubſtances obtainable from human urine.*
21. *The ſalt predominant in human urine.*
22. *The empyreumatical oil, or oils of urine.*
23. *The* mellago *or rob of human urine, and its uſes.*
24. *The* terra damnata *of human urine.*
25. *Some accidental differences of human urine, as 'tis emitted in the morning, at certain diſtances from meals, or after the uſe of certain aliments, or medicines, as ſparagus, turpentine,* &c. *or at differing ſeaſons of the year.*
26. *The affinity of human urine with other bodies, eſpecially the vegetable and mineral.*
27. *The hoſtility of human urine with acids,* &c.
28. *The affinity and difference between urine, blood, gall, milk,* &c. *and other liquors, or animal juices; particularly the compariſon between human urine and that of brutes.*
29. *The mechanical uſes of human urine.*
30. *The chymical uſes of human urine, and its parts, eſpecially as menſtruums.*
31. *The medicinal uſes of human urine, external and internal.*
32. *Particulars omitted, relating to the hiſtory of human urine.*
33. *Promiſcuous obſervations, experiments and inquiries about human urine.*

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to make the proper trials for inveſtigating the nature, or examining the qualities of a water propoſed: ſince the ſubject may hence be viewed on all its ſides; and a conjecture be made, as to what ſaline, or other known minerals, and what quantities of them, impregnate the water; and, conſequently, what effects 'tis likely to produce in human bodies.

The neceſſity there is for it.

As to diſcover the nature of mineral waters, is a far more difficult taſk than thoſe who have not tried wou'd imagine; we ought to view the ſubject in as many different lights as we can expoſe it to; and take in all the helps to the diſcovery we can; ſince a great many particulars that ſingly, or at the firſt view, ſeem not very pertinent, yet if ſurvey'd in conjunction, and ſkilfully applied, may greatly conduce to the deſired end. And I have here been the larger in my enquiries, becauſe many obſervations have perſuaded me, that phyſicians ought to conſider very well the nature of the waters they preſcribe; to what perſons; for what diſeaſes; and in what manner they employ them. For tho' many look upon theſe waters as ſuch innocent medicines, that if they do no good, they can do no harm; yet the effects which have too often enſued upon the unſkilful uſe of them, eſpecially when long continued, ſhew the drinking of them to be no ſlight thing, that may ſafely be play'd with: for I have ſeen very great ſervice, and very great miſchief done thereby; and the latter, in particular, ſome time after their operation is thought to be over, and perhaps forgotten.

And I look upon the examination of the properties and qualities of mineral waters, as a thing of the greater importance, becauſe I ſuſpect, upon probable grounds, that by a diligent ſearch there may be diſcovered, both in *England* and other countries, a far greater number of them than is yet imagined, eſpecially ferruginous ones; for by ſome uncommon trials, I have found, that ſeveral minerals, which men either knew not what to make of, or by reaſon of their paſſing under other names, did not ſuſpect to be chalybeate, abounded in parts of that nature. And as our globe is providentially furniſhed with a far greater plenty and variety of iron-ores and minerals, partaking of that metal, which is the moſt uſeful by far to mankind; ſo they are more diſpos'd than one wou'd expect from ſuch hard bodies, to impregnate liquors, not manifeſtly acid, and that ſeem unlikely to work upon minerals much ſofter than they. To make this probable; upon the minute filings of pure ſteel, we put ſome tincture of galls made with common water, that had been filtred through cap-paper; and found, that in leſs than an hour, the tranſparent infuſion of galls was alter'd to a dark, and almoſt inky colour, which it retained even after filtration; and this, tho' the vial that contained it was very ſlender. A like effect was produced by ſmall filings of ſteel, but ſomewhat more ſlowly, in the red tincture of brazil, and alſo in that of log-wood made with common water.

In

In countries manifeſtly abounding with metalline and other minerals, it may, perhaps, be worth while to deſcend much lower than the ſuperficies of the ground, to make ſearch after ſubterraneal ſprings and wells, and their operations upon human bodies. For I have been aſſured by thoſe who had viſited mines, that ſometimes, at very great depths therein, they have found running, as well as ſtagnant water, of different taſts and qualities; and that the diggers, venturing to make uſe of them, diſcover'd ſome to be miſchievous, and others innocent and medicinal. Of both theſe ſorts we have inſtances in our tin-mines of *Cornwal*; and as to the latter, an ingenious gentleman, who has the over-ſight of ſome *Corniſh* water-works, tells me, that, in the bottom of a tin-work, called *Karnkey*, wrought above ſixty fathoms deep, the mineral was a mixture of tin and iron, and the water red and thick, yet drank cool and pleaſant, and paſs'd by urine near as red as it was drank; "as I have been informed," ſays he, "by thoſe who uſed it whilſt "the mine was working; but the vein of ore is now degenerated or loſt." MEDICINE.

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HE who wou'd draw up the hiſtory of a mineral water, to have its qualities examined or diſcover'd, ſhou'd, in my opinion, make three ſorts of obſervations about it. And firſt, upon thoſe particulars that relate to it, whilſt yet under ground, or in its native receptacle; next upon its properties, and qualities, when drawn up at the ſpring-head, or other receptacle; and laſtly, upon the operations and effects of it in the human body, both diſtemper'd and in health, according to the ſeveral methods and circumſtances of its adminiſtration. To the firſt of theſe obſervations, the following heads are referable. *Heads for the natural hiſtory of a mineral water, conſidered in its channel or receptacle.*

1. *In what climate and parallel, or in what degree of latitude, the mineral water ſprings up, or ſtagnates.*

2. *Whether the ſpring-head, or other receptacle, chiefly regards the eaſt, the weſt, the north, or the ſouth.*

3. *Whether the water be found in a plain, or a valley; and if not, whether it riſes in a hillock, a hill, or a mountain.*

4. *Whether it be found at the top, the middle, or the bottom of the riſing ground.*

5. *Whether the water leaves any recrement, or unuſual ſubſtance, upon the ſtones, or other bodies, that lie in the channels it paſſes through, or in the receptacles that contain it.*

6. *Whether there lie beneath, or near the medicinal water, any ſubterraneal fire, that hath manifeſt chimneys, or vents, and viſibly by night only, or by day, burns, or ſmokes, either conſtantly, or at certain periods.*

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7. *Whether at, or near the mouth of these vents, there be found either flours of brimstone, a salt like sal-armoniac, or other mineral exhalations, in a dry form.*

8. *Whether there be under, or near the course, or channel of the water, any subterraneal estuary, or latent mass of hot, or visibly burning materials: and whether such estuary afford an uniform heat, as to sense; or have hot fits, as it were periodically; and if so, whether these come at certain and stated times, or irregularly.*

9. *Whether over the estuary, or in some other part, near which the mineral water springs, there arise any visible mineral fumes, or smoke, early in the morning, or late in the evening; and if such fumes ascend, in what plenty, of what colour and scent.*

10. *What is the more obvious nature of that part of the soil, which appears not manifestly metalline, or marcasitical, and which the medicinal water passes through, or touches upon: and what are the qualities of the neighbouring soil, and the adjacent country; as whether it be rocky, stony, clayish, sandy, chalky,* &c.

11. *Whether there be any ores, marcasites, or earths, especially high-coloured ones, impregnated with mineral juices, to be met with in the course of the medicinal spring, or in the receptacle of the same water: and what these minerals are, whether copperish, ferruginous, marcasitical,* &c. *and whether the ores do, or do not abound in the metalline portion; as, also, with what other ingredient, as spar, cauke, sulphur, orpiment, arsenic,* &c. *they are mix'd or incorporated with.*

12. *Whether the spring of the medicinal water, was common water, before it came to any particular part of the soil it runs through, and there begins to be manifestly impregnated with mineral bodies.*

13. *And whether, in this case, it makes any effervescence, or other conflict, with the mineral it imbibes, or with any other water, or liquor, that it meets with in its way; and whether the conflict produce any heat or no.*

14. *Whether, if the mineral water be manifestly hot, or extraordinarily cold, the spring it flows out at, or the receptacle it stagnates in, have near it a well of water, of a contrary quality; as is observed in a few places of* France, *and elsewhere.*

15. *Whether, when the water appears in the spring, or receptacle, there float at the top, lie at the bottom, or swim between both, any drops, or considerable quantity of oil, like* Naphta, *or other bituminous, and inflammable substance.*

16. *Whether the water be considerably alter'd, in quantity or quality, by the different seasons of the year; by the varying temperatures of the air, as to heat, coldness, drought,* &c. *by the plenty or paucity, frequency or unfrequency of falling rains, or snows; and what may be the bounds, or measures of these alterations in the water.*

The effects of rain upon a mineral spring.

'Tis known, that the drinking of ferruginous waters, such as the *German-Spaw*, and of *Tunbridge*, is usually prescribed for many weeks; during which time it often happens, that the fall of rains occasions a doubt, whether they be not so much diluted thereby, as to be spoil'd in their medicinal capacity: and, indeed, I more than once observed, that

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them; and alſo deliver ſome practical ways of tryal, as the ſubjects ſhall require.

1. *Its actual coldneſs or heat.*

The heat or coldneſs of a mineral water, what it denotes; and how it is to be eſtimated.

The knowledge of the degree of coldneſs in the water, eſpecially if it be extraordinary, may lead one to conjecture, whether the ſpring aſcends from any conſiderable depth under ground, or whether it runs through a ſoil abounding with ſalt-petre, ſal-armoniac, or ſome ſuch very refrigerating ſubſtance.

The degree of the water's coldneſs or heat may be eſtimated ſeveral ways; as by its having or not having the power to coagulate eſſential oil of aniſeed or fennel-ſeed; by its being, or not being able to melt bodies, of different diſpoſitions to fuſion, as butter, tallow, bees-wax, *&c.* to coagulate the whites of eggs, or dreſs them in their ſhells, *&c.* but the beſt method is to plunge into the water the globulous part of a good hermetically ſealed thermometer, whereon the degrees of cold and heat are carefully mark'd.

2. *Its ſpecific gravity.*

The advantages of knowing the ſpecific gravity of a mineral water.

The knowledge of the ſpecific gravity of a mineral water may be of great uſe to diſcover its nature; not only by enabling men to diſtinguiſh that from other waters, but by affording a conſiderable and double information. For by comparing the weight of the propoſed liquor with that of common water, we may, in caſe the former proves the heavier, be aſſiſted to eſtimate with what proportion of ſalt, ferruginous, or other mineral ſubſtance, it is impregnated; and if it be very light, or lighter than common water, it may, with probability, be concluded, that the ſubſtance that impregnated it, is either very ſmall in quantity or proportion, but of a ſpirituous and volatile nature; which is a diſcovery of no ſmall moment in this affair. And tho' it may ſeem a paradox, that the water impregnated with a metalline or mineral ſubſtance ſhould be lighter than common water; yet upon tryal, carefully made, I have found ſome mineral waters, as particularly that of *Tunbridge*; that of the *German-Spaw*, and of ſome of the *Iſlington* ſprings, to be manifeſtly lighter than common water: and ſome taken up at *Tunbridge*, has prov'd lighter than common water, purified by diſtillation.

Yet I would not in all caſes refer this ſurprizing levity to the admixture of lighter corpuſcles; becauſe ſome tryals have convinc'd me, that much of the comparative lightneſs proceeds from the mineral waters poſſeſſing a ſmaller quantity of common ſalt than ordinary water contains. My experiments, however, did not ſatisfie me, that this want of ſalt was the ſole or adequate cauſe of the lightneſs of the waters I examined.

The method of determining it, ſhewed by examples.

But to diſcover ſuch minute differences, requires exact inſtruments; and, indeed, to ſpeak freely, there are few upon whoſe reports I durſt confidently relie for the ſpecific gravity of mineral waters. To weigh liquors with accuracy, more care and ſkill muſt contribute with nicer in-

inſtruments than often fall to one man's ſhare. And yet when phyſicians, or others, weigh mineral waters, they uſually do it in an apothecary's ſhop. The moſt accurate method, that I am acquainted with, to compare the different weights the ſame ſinking body has in common water, and in the liquor propos'd, requires ſkill in hydroſtatics, as well as good inſtruments, and is practicable by few. The way of comparing waters by the greater or leſſer degree of ſubmerſion of the ſame cylinder, or other floating body, is ſcarce accurate enough; wherefore, I choſe to make uſe of a very thin round vial, with a flattiſh bottom, that it might ſtand upright, and be very light, which was furniſhed with a neck as long as a gooſe's quill, drawn very even into a hollow cylinder of above three inches long, and fitted at the top with a little gap, to hinder the water from aſcending above the due height.

This glaſs contain'd three ounces, a half, and forty-three grains of common water, yet, when empty, weigh'd but ſix drams, and forty-two grains; whence I cou'd uſe it, in ſuch a balance, that the addition or detraction of half a grain, or leſs, would make either ſcale preponderate; ſo that, tho' capable of holding water enough for accurate tryals, yet when filled, 'twas not too heavy for a tender balance. In this veſſel, therefore, we carefully weigh'd ſeveral liquors, and among others, different mineral waters; ſome of which we found as follows; the glaſs being always fill'd to the ſame height, and weighed in the ſame balance.*

		oz.	*dr.*	*gr.*
Common water	Weighed	3	4	43
Common water diſtill'd		3	4	41
Acton water		3	4	48½
Epſom water		3	4	51
Dulwich water		3	4	54
Stretham water		3	4	55
Barnet water		3	4	52
North-hall water		3	4	50
German-Spaw water		3	4	40
Tunbridge water		3	4	38
Iſlington water, from the muſic-houſe		3	4	36
Iſlington water, from the vault with ſteps		3	4	39
Iſlington water, from the cellar		3	4	39

From hence it may appear, that as ſeveral mineral waters, which contain ſalts, are conſiderably heavier than common water; ſo ſome,

* Water will have different denſities, according as the warm or cold air affects it; whereby a mineral water may be conſiderably influenced, if carried far from the ſpring, before 'tis examined. See *Philoſ. Tranſ.* N°. 315. *p* 269.

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especially ferruginous waters, are impregnated with such a fine substance, as to be lighter than common water.

3. *Its transparency, muddiness, or opacity.*

4. *Whether the mineral water will, by standing, let fall, of it self, any oker, or other earthy substance, especially if the liquor be kept from the air.*

The natural precipitate of a mineral water, to what discoveries it may lead.

This article may frequently help to discover what kind of soil the water has passed through, and is also useful to distinguish the spontaneous residence that the liquor lets fall by mere standing, from that they call the *Caput mortuum*, which remains after the total evaporation of the water; by which means, also, the weight of the latter may be more truly known. Not to mention other mineral waters, I found some from the *German-Spaw*, brought very well stopp'd, to *London*, afforded, by long standing, a pretty quantity of terrestrial substance, that look'd almost like yellow oker, and perhaps was greatly allied to it in nature. The article mentions if the liquor be kept from the air, because I have found that some liquors, by being exposed to the free air, wou'd have copious and surprizing substances separated from them, as if the air contain'd some precipitating salts fit to work on the fluids.

Microscopical observations to be made upon mineral waters.

5. *Whether any thing can be discovered in the mineral water, by means of the best microscopes, well adapted to view it.*

Having caused a young person, who was used to microscopical observations, to look upon some mineral waters through the best glasses; he could discern no difference between them and common water. But notwithstanding this, the tryal ought to be repeated by various persons, on several waters, with different microscopes, in differing lights.

'Tis thought by several ingenious persons, that the little bodies discovered by Mr. *Leeuwenhoeck*, and since by others observed in pepper-water, are not living creatures, but little inanimate concretions casually form'd and carried up and down in the liquor. But the following experiment shews the contrary. Having laid upon the microscope part of a drop of water, wherein I saw numberless particles in brisk motion, we then put to that liquor with a bristle, part of a drop of spirit of salt, which, as we expected, presently deprived them of their motion, and left them to be carried slowly to and fro in the liquor; so as to make it visible that they were then dead, and were alive before.

6. *Its colour.*

7. *Its odour, whether acetous, vinous, sulphureous, bituminous,* &c.

Various odours observable in different mineral waters.

The odours of several mineral waters are best judged of at the spring-head, or other receptacle, whence some of them being remov'd, scarce afford any odour at all, preceptible by us.

Perhaps the sulphureous scent that is sometimes perceiv'd in *Tunbridge* and other waters, in their sources, may, in part, proceed from loose exhalations that casually happpen to be mixed with, but do not constantly belong to the water.

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But the ſame *Spaw* water being, in the ſummer-time, kept all night in an open veſſel, did, till late the next morning, retain a diſpoſition to be made purple, by the admixture of galls; but it loſt that diſpoſition before the next day.

10. *The thinneſs, or viſcoſity of the mineral water.*

11. *Whether the water be more eaſily heated and cooled, dilated and condenſed, than common water.*

12. *Whether the mineral water will, of it ſelf, putrefy; and if ſo, whether ſooner or later than common water; and with what kind, or degree, of ill ſcent, and other phenomena.*

13. *The change of colours producible in it by aſtringent drugs, pomegranate peels, balauſtians, red roſes, myrobalans, oak leaves,* &c. *as alſo by ſome juices of the body.*

Remarks upon the common methods of examining mineral waters by galls.

Since the change of colour that mineral waters produce in the infuſion, or tincture of galls, is the moſt uſual, and almoſt the only way whereby phyſicians examine them; I ſhall ſet down ſome remarks which I have made about this method of proof; and the rather becauſe it may, *mutatis mutandis*, be uſefully applied, to find the qualities of mineral waters, by colourations made with other materials. Firſt then, it may be obſerved, that an infuſion, or tincture of galls in common water, is not neceſſary to try if a new colour will by them be produced. I uſually keep their powder in a glaſs, exactly ſtopt, to have them in readineſs to mix with the water, and ſo alter its colour immediately, if galls will do it; for to draw the tincture of galls with ſimple water, often takes up ſeveral hours; and the the tinging parts are, alſo, much weakned by being diluted. But if a tincture be required, the powder of galls tied cloſe up in a rag, and hung in the liquor, makes the infuſion leſs muddy.

I have obſerved thoſe parts of the infuſion of galls, eſpecially when made by heat, that produce the new colour with ferruginous waters, are very apt to fly away; the infuſion often becoming unfit to alter the colour of the waters, whilſt it ſelf appears high-coloured. Upon which account, I chooſe to make the tincture of galls a little before I uſe it; or if I employ dry galls, to take powder that is not ſtale.

'Tis no ſafe way, and may prove very erroneous, to mix galls, or their infuſion, careleſly, with the water to be examined; for thoſe who are curious to make good ink, will be eaſily perſuaded, that the deepneſs of the colour, greatly depends upon the proportion of galls to the other ingredient; and, accordingly, that by putting a much greater, or a much leſs quantity of galls, into a certain quantity of a mineral water, the colour reſulting may be more or leſs intenſe. To obviate this inconvenience, I make my infuſion with a certain weight of the powder, in a determinate weight of water; for inſtance, I put about five grains of powder'd galls, to ſteep for five hours, in an ounce of water; but if I uſe the dry powder, I put three or four grains into an ounce of the liquor to be examined; which is a way far more cer-

certain than the common, where the ingredients are eſtimated by gueſs. Different proportions of powder'd galls are applicable to the ſame quantity of liquor; for I have obſerved, that there is a great inequality among the mineral waters, in which it may be employed. I have found by trial, that in an ounce of the *German-Spaw* water, a ſingle grain of that powder wou'd immediately produce a deep purple colour.

'Tis an inconvenience, that not only galls, but other drugs, impart a high tincture of their own, to the common water wherein they are infuſed; and, therefore, it were to be wiſh'd, we had ſome drug, that, without communicating a colour to the common water it impregnates, wou'd afford an infuſion fit to ſtrike a blackiſh, or a purple colour, with ferruginous waters.

Tho' it be uſeful, 'tis not always neceſſary, to employ galls, to ſtrike a colour in mineral waters; for the ſame thing may ſometimes be done, tho' more faintly, with oak-leaves; and we may ſucceſsfully ſubſtitute for the ſame purpoſe, ſome other aſtringent vegetables, as dry'd red-roſe leaves, the peel and juice of pomegranates; and that notable ſtyptic, the bloſſoms of the ſame plant, vulgarly called balauſtians; to which may be added, myrobalans, log-wood, *&c.* the ſtrong infuſions whereof I have found to give a tincture very dark and blackiſh, with ſome ferruginous liquors.

Since the galls, *&c.* to be infuſed in common water, are not always of the ſame goodneſs or ſtrength, 'tis adviſeable, not ſo to truſt to any determinate proportion thereof to the water, without the aſſiſtance of the eye, to judge by the colour of the tincture, whether the liquor be duly impregnated.

'Tis hinted, that animal liquors may be employed to produce new colours with mineral waters; becauſe 'tis uſually obſerved in the ferruginous kind, ſuch as thoſe of *Tunbridge*, the *Spaw*, &c. that the groſs excrements of the lower belly, are blacken'd by a mixture of their metalline parts; and in *Tunbridge* waters, particularly, I have obſerved, that after the drinking of large doſes of them, the root of the tongue, and, perhaps, ſome neighbouring parts, wou'd alſo acquire a dark colour.

Tho' the way of trying mineral waters, by the change of colours produced in them by galls, be uſeful, and recommended by being eaſy, cheap, and expeditious; yet I do not take it to be either of that extent or certainty as is vulgarly preſumed. For, perhaps, its only conſiderable uſe is, to diſcover by ſtriking or not ſtriking a blackiſh or purpliſh colour with a mineral water, to manifeſt it to be, or not to be, either of a vitriolic, or a ferruginous nature. But there are many metalline ores, and other mineral bodies, which, not participating of iron, will remain undiſcoverable by this means, and yet ſtrongly impregnate the water. Thus, for example, to try, whether, if arſenic were mingled with water, galls would diſcover it, by producing a dark colour therewith; I put ſome of the powder of them into a decoction

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of arſenic, but did not perceive it gave the liquor any deeper colour, than it would have done to common water. And as this method is but of ſmall extent, ſo neither do I find the informations it gives us, to be ſo certain as they are preſum'd. For, I long ſince found, upon trial purpoſely made, that another body of a metalline nature, which partook not of iron, wou'd, with the infuſion of galls, afford a very dark colour, that might eaſily paſs for the colour produced by a ferruginous water. And I ſuſpect, that all liquors impregnated with iron, are not diſcoverable by the colour they afford with galls; for I have ſometimes made ſuch a liquor, with no other mineral ſubſtance in it beſides ſteel or iron; but I did not find it wou'd turn the infuſion of galls either blackiſh or purple: which led me to imagine, that theſe colours are afforded only by ſuch ferruginous waters, as have been wrought upon, more or leſs, by ſome acid ſalts or fumes.

I might add, 'tis a miſtake that the infuſion of galls will certainly diſcover a mineral water to be vitriolic, by becoming black or purple therewith. This holds true, indeed, if in the vitriolated water, iron be the predominant mineral, or conſiderably participated by the liquor; but if the diſſolved vitriol be altogether copperiſh, I have found, by ſeveral trials, purpoſely made with a ſtrong ſolution of *Roman* vitriol, that it wou'd not, with the infuſion, or tincture of galls, afford either a black, or a blackiſh, but only a thick and muddy colour.

I remember, that from the northen part of *England*, where there are ſeveral mineral waters, a virtuoſo ſent me a large quantity of very whitiſh earth, which he ſuſpected to be of a peculiar nature. Upon examination, it appeared to contain a conſiderable proportion of lead-ore, corroded by ſome mineral ſalts, and incorporated with the ſoil; ſo that if ſearch had been made for mineral waters, in the place from whence this earth came, 'tis probable, that ſome peculiarity being found in the taſt of the water which paſs'd thro' the ſame, it would have been taken for a mineral water, tho' it wou'd have been hard to determine what mineral it partook of; and, perhaps, by endeavouring to ſolve the doubt, by drinking it, very bad effects might have thence enſued. But, probably, the ſulphureous ſpirit we ſhall preſently deſcribe, wou'd have ſhewn that water to be impregnated with a body of the nature of vitriol, but not the common ſort. For tho' galls give no very blackiſh colour to a ſolution of *Saccharum Saturni*, that is, the vitriol of lead, in diſtill'd or rain-water; yet I found this volatile ſulphur wou'd ſoon manifeſtly do it: which expedient I made uſe of, becauſe I had not then at hand the ores of lead, copper, *&c.* For the ſame reaſon I contented myſelf with the ſolutions of the ſeveral metals in their proper menſtrua; for 'tis probable, that the metalline parts of the ores, wou'd have afforded either the ſame, or ſimilar ſolutions, in the ſame menſtrua; which conſiſting of nitre, ſea-ſalt, and vitriol, bodies that abound in ſeveral parts of the earth thro' which ſprings flow, their ſeveral impregnated waters might exhibit phenomena of

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without greatly diſcolouring it ; when the ſuperfluous duſt was ſtruck off, it became capable of affording a variety of colours, or rather ſhades, ſome deeper, and others fainter ; and then I let drops of different ferruginous liquors fall thereon. Several variations of colour may, likewiſe, be produced by infuſing, or otherwiſe mixing a material with the mineral water, before the tinging one be joined with it ; by putting ſomewhat into the infuſion or powder of galls, before it be added to the water ; or, laſtly, by dropping proper liquors, ſuch as ſpirit of ſalt firſt, then ſpirit of urine, or oil of tartar, into the mixture of galls, and the ſubject to be examin'd. (3.) It is not proper to confine one's ſelf to the uſe either of galls or oak-leaves ; red-roſes, balauſtians, log-wood, brazil, and other aſtringent vegetable pigments, may be alſo employ'd. For tho' ſome of theſe give a deeper tincture than galls, yet, by the diverſity of colour they produce in mineral waters, an attentive ſpectator may diſcover ſome things that he would not be informed, or receive any hint of, by the help of galls or oak-leaves alone. Nor would I have only vegetable ſubſtances employ'd about ſuch colourations, but ſometimes animal, and often mineral ones ; for by this means, experiments will be diverſified, and the number of phenomena encreaſed ; ſome of which may, probably, prove inſtructive. I know ſeveral other ſubſtances that will, as well as galls, turn black in vitriolic waters, whether of the iron or copper kind. And for a liquor that will preſently turn black with either : take equal parts of pure ſalt of tartar, flours of ſulphur, and good ſal-armoniac, reduce the firſt and the laſt to powder ſeparately, melt the ſulphur, over a gentle fire, and, by degrees, put to it the ſalt of tartar ; ſtirring them well, that they may incorporate and grow reddiſh ; then put the mixture pulverized, into a glaſs-retort, pour on it the ſal-armoniac diſſolv'd in fair water ; and cloſing well the junctures, diſtil all in ſand, by degrees of a moderate fire ; ſhifting the receiver once or twice, becauſe the liquors will be differently ting'd and ſtrong, and that which aſcends laſt, may bring over but very little of the ſulphur, whoſe volatile tincture is yet the chief thing we aim at in this operation. (4.) I queſtion not, that he who makes a ſkilful uſe of the ſeveral drugs, and other bodies, vegetable, animal, and mineral, which may produce new colours with mineral waters, or the ſubſtances that impregnate them, will thereby diſcover the preſence or abſence of many other minerals therein, ſome of them ſalubrious or ſafe, and others hurtful or dangerous, that remain unobſerv'd by thoſe who content themſelves to employ only galls and oak-leaves in the examination of them. For ſome of theſe liquors contain ſalts that, having corroded, either iron or copper ores, or marcaſites, do not betray themſelves, by producing either an inky, a fainter degree of blackneſs, or a purple, with the drugs commonly made uſe of to change their colours. And of theſe ſalts I have met with more than one ſort. (5.) I think, it, likewiſe, very poſſible, that induſtrious men may find means to diſ-

diſcover, by the help of this change of colours, whether orpiment, native arſenic, or the like poiſonous minerals, impregnate a water, ſo as to make it very hurtful or dangerous. But as for ſulphur, ſeveral waters may partake thereof without being perceived to do ſo. I have, ſometimes, purpoſely made a liquor, limpid like ſpring water, that would totally evaporate by a gentle heat; and yet this liquor was highly impregnated with a mineral ſulphur, as I convinc'd ſeveral virtuoſi by manifeſt and ocular proofs. So that if ſulphur chance to be combined with any of thoſe many hidden ſubterraneal ſalts and minerals, that can ſuppreſs or diſguize its peculiar odour, a water may be conſiderably, tho' unobſervedly impregnated with it: yet this is, probably, diſcoverable by the change of colour, producible in ſuch a ſulphureous liquor by vitriolic bodies, and other proper materials; for tho' the ſpirit lately deſcrib'd be very tranſparent, and totally volatile in the form of a liquor, ſometimes pale; yet common *Engliſh* vitriol, as alſo that of *Dantzick*, which is of the copper kind, will preſently turn it of a black or very dark colour. And, what ſeems more difficult, I have deviſed a method whereby it appears, that even ſolid copper may be ſo ſubtiliz'd and diſguiz'd, as to ſend out a multitude of its metalline parts, with others, in the form of a tranſparent liquor, like common water; when by putting to it a little of another ſubſtance, as volatile and colourleſs as it ſelf, it would preſently diſcloſe the metal it contained, by turning blue as a ſapphire. (6.) Becauſe arſenic is a pernicious drug, and yet has been ſuſpected to be clandeſtinely mixed with mineral waters; which ſeems the leſs improbable, becauſe ſome of the marcaſitical bodies, waſh'd by particular mineral waters, are thought to contain it; and becauſe galls fail'd to diſcover this poiſonous drug in water, that was copiouſly impregnated with it, I made ſome trials, to diſcover, at once, its exiſtence in water, and the nature of ſo dangerous a mineral.

To diſcover whether a mineral water be arſenical.

Happening, ſome years ago, to taſt arſnic, not without a little danger and inconvenience, its poiſonous nature did not from thence ſeem to me to conſiſt in a highly acid ſalt, but to be of an exceeding coroſive or fretting nature, peculiar to it ſelf. Of this mineral I made a ſtrong ſolution in common water, wherein ſome ſkill is required to diſſolve it, and mix'd a ſmall proportion thereof with ſome *German-Spaw* water; then dropping into this mixture a little highly dephlegmed ſpirit of urine, we perceiv'd a light lacteſcence to be produced, and a whitiſh precipitate very ſlowly to ſubſide therein.

We found, alſo, that a little oil of tartar *per deliquium*, being drop'd into ſome of the ſolution of arſenic, produced a heavy, whitiſh cloud, which preſently ſettled on the lower part of the glaſs: we, likewiſe, put oil of vitriol into the ſaid ſolution, but did not perceive that the oil cauſed a precipitation, or wrought much otherwiſe on it than it would have done upon common water.

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From which experiments it may be ſuſpected, that arſenic is chiefly an acid body.

But by mixing ſome of this arſenical liquor with ſyrup of violets, we found it ſlowly change the ſyrup, rather to a green, than a red or purple colour: and to another portion of the ſame liquor we put ſome of our volatile ſulphureous ſpirit, but no precipitation enſued.

For a ſeverer ſcrutiny, we uſed a method, that is very ſucceſsful in diſcovering ſuch ſlight degrees of acidity as are not diſcoverable by ordinary tryals; but we cou'd not, by this way, diſcern the leaſt acidity in our arſenical ſolution, but rather a manifeſt ſign of an urinous or lixiviate quality. And by putting ſome of the arſenical liquor into a ſtrong ſolution of common ſublimate, made in fair water, we had a copious precipitate, ſuch as might have been expected from an alkaline precipitant. And this was not brick-coloured, like what fix'd alkalies produce with diſſolv'd ſublimate, but white; ſuch as urinous or volatile alkalies, as they call them, make with the ſame liquor.

Upon the whole, tho' arſenic be a very corroſive body, and, perhaps, upon that ſcore poiſonous; yet its deleterious nature ſeems not to conſiſt in a tranſcendently acid, lixiviate, cauſtic quality; but, as we before conjectured, in a peculiar kind of corroſiveneſs.

I ſhall add, that upon caſting about in my thoughts for an uſeful method to examine mineral waters, ſuſpected to contain arſenic; I, at length, made choice of vitriolate bodies for that purpoſe; and found, that if a ſolution of *Dantzick* vitriol were put to a convenient quantity of arſenical liquor, there would preſently enſue a great change of colour; and a dark ſubſtance, by degrees, precipitate it ſelf, and ſettle in the lower part of the glaſs. The like effect we found when we put *Engliſh* vitriol, (which having no copper added in its preparation, as that of *Dantzick* has, is either wholly, or almoſt ferruginous) into a conſiderable proportion of the arſenical ſolution.

14. *If any thing will be precipitated out of the mineral waters by ſalts or ſaline liquors; whether they be acid, as ſpirit of ſalt, or of nitre,* Aqua fortis, *&c. volatile alkalies, as ſtrong ſpirit of urine, ſal-armoniac,* &c. *or lixiviate ſalts, as oil of tartar* per deliquium, *fixed nitre,* &c.

15. *To examine, by evaporation, whether the mineral water contains common ſalt, and if ſo, whether in a great or ſmall quantity.*

Common ſalt contained in mineral waters.

Becauſe it often happens, that men have not the leiſure and conveniency totally to evaporate a mineral water, it may be uſeful, without evaporation, to diſcover, whether it contains any common ſalt; and if ſo, to make ſome eſtimate how copiouſly or ſparingly the liquor is impregnated therewith. This I might eaſily ſhew how to perform exactly, if I were not juſtly reſtrained, for a while from communicating that way of examining the ſaltneſs and freſhneſs of waters, whereof, by the king's command, I exhibited to his majeſty ſome proofs, ſoon after mentioned in the *Gazettee*; however, ſome gueſs may be made at the ſaltneſs of waters by obſerving whether they will lather with waſh-

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alter'd, as to ſuffer an obſervable change in any of its manifeſt qualities; and if it do, in what qualities, and to what degree of alteration.

There is a double deſign in this enquiry: Firſt, to diſcover whether a change of texture wou'd remarkably alter the qualities of the liquor, when the hermetical ſeal hinder'd the avolation of any ſaline, ferruginous, or ſpirituous parts: and, ſecondly, to ſee whether ſuch an agitation by heat, as in the open air, prevents the *Spaw* water from making a purpule colour with galls, wou'd cauſe any manifeſt ſeparation of parts in the liquor, and cauſe any groſſer ſubſtance to precipitate, or ſubſide. We twice attempted the experiment with *Spaw* water, but without ſucceſs; for the firſt time, the glaſs broke at the bottom, before the water, wherein we immers'd it, was near boiling hot; and tho' the other glaſs reſiſted longer, and endured a greater heat, yet in a few minutes that alſo broke at the bottom: which diſappointments a faithful hiſtorian ought not to conceal.

21. *What proportion the dry* Caput mortuum *bears to the mineral water that affords it.*

22. *The diviſion of the* Caput mortuum *into ſaline, terreſtrial, and other parts not diſſoluble in water, in caſe it contain both, or more ſorts.*

23. *The proportion of the ſaline part of the* Caput mortuum, *to the terreſtrial.*

24. *The fixity, or volatility, of the ſaline part in ſtrong fires.*

25. *Whether the ſaline part will ſhoot into cryſtals or no; and if it will, what figure the grains are of; but if it will not, whether, being combined with a ſalt of that property, as purified ſea-ſalt, for inſtance, it will then cryſtallize; and if it do, into what figures it ſhoots, and, particularly, if they are reducible to thoſe of any ſpecies of known ſalts.*

26. *To examine whether the ſaline part be predominantly acid, alkaline, or adiaphorous.*

To find what ſalts predominate in particular mineral waters.

Various ways may be propoſed, to diſcover which of the qualities mentioned in this article, is predominant in the ſalt to be examined; but, I confeſs, I doubt whether any of them be certain.

If acidity be the predominant, it will, probably, appear by the taſt, odour, or both; by working upon powder'd coral, or crabs eyes, curdling milk, turning ſyrup of violets reddiſh, deſtroying the blue colour of the infuſion of *Lignum nephriticum*, by not precipitating with ſtrong acid liquors, as oil of vitriol, ſpirit of ſalt, *&c.* and, laſtly, by precipitating with oil of tartar *per deliquium*, ſtrong ſpirit of urine, *&c.* But I ſtill doubt, whether theſe proofs be abſolutely certain; for, if I miſtake not, I found ſome purging mineral waters, that wou'd not give even ſo ſlight a proof of acidity, as to deſtroy the blueneſs of the nephritic tincture, tho' they wou'd curdle milk; and, on the contrary, I found, that ſome *Spaw* water wou'd not curdle milk, and yet readily deprive the ſaid tincture of its colour: which ſome of our *Engliſh* ferruginous waters were, at leaſt when brought to *London*, unable to do.

The predominancy of an alkali in the ſalt of a mineral water, may be, probably, diſcovered by the lixiviate taſt and ſmell; the former

of

of which may be obſerved in the true nitre of the ancients; by turning the ſyrup of violets green; by precipitating a ſolution of ſublimate, made with ſpring-water; by an efferveſcence, or conflict with ſome potent acid, as *Aqua fortis*, or well dephlegmed ſpirit of ſalt; by heightning the red tincture of log-wood, or brazil, drawn with common water; to which may be added, a nicer way or two, that I have elſewhere mentioned. But I propoſe theſe methods of examination, only as they appear rational; becauſe I have ſucceſsfully tried them with other ſaline bodies, that were alkalizate: for, as to thoſe mineral waters I have examined, an alkali appeared to be predominant in none of them.

But further enquiry may diſcover to others here in *England*, what I have not yet met with: doubtleſs there are in many parts of the earth, ſalts of an alkaline nature. And, I preſume, the *Egyptians* might find, among their ſprings or wells, ſeveral waters impregnated with them; for I found by trials, purpoſely made, upon the true *Egyptian* nitre, that the native ſalt exhibited ſeveral of the ſame phenomena, with other factitious alkalies: and ſome ſalt afforded by the famous waters of *Bourbon* in *France*, being brought me to examine, I found it to be evidently alkaline; for it wou'd make a conflict with acids, and preſently turn ſyrup of violets green.

If we ſuſpect vitriol to predominate in the ſaline part of a mineral water, we may endeavour to diſcover it, by its blackning a ſolution of galls; by its vomitive operation upon the drinkers; (tho' this may ſometimes prove uncertain; eſpecially becauſe an inviſible mixture of arſenic, or, perhaps, arſenical fumes, may give the water an emetic quality;) by putting alkalies to a ſtrong ſolution of the ſuppoſed vitriol, and obſerving whether it will afford a yellow, or a yellowiſh precipitate, if ſalt of tartar, or ſpirit of urine, be dropt into it; and, laſtly, by taking notice, whether a ſulphureous ſpirit will make a blackiſh, or a very dark colour with it; as I found it would do with ſeveral vitriolic liquors; and even in one, wherein we had diſſolved but a grain of a natural vitriolic ſubſtance, in above four or five thouſand times its weight of ſyrup or water. But I do not remember to have found vitriol a manifeſt ingredient in any of the waters about *London*: which ſeems the more remarkable, becauſe ſeveral places about that city abound with marcaſites, the parents of vitriol. And a curious *French* gentleman, who had a particular occaſion to take notice of the ſediments of many mineral waters in his own country, told me, he never met with any that was manifeſtly vitriolic: and he ſeem'd to be of opinion, that no vitriolic ſpring had yet been diſcover'd, among the many mineral ones of *France*.

Since we ſo rarely meet with either manifeſtly acid, or evidently alkaline ſalts, in our *Engliſh* mineral waters; it may deſerve a ſerious enquiry, what other ſalts they may be impregnated with; and eſpecially from what ſalts, the purgative virtue that is found in many of

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27. *The obſervables in the terreſtrial portion of the* Caput mortuum, *in reference to the ſaline; its colour, odour, volatility, or fixity in a ſtrong fire; its ſolubility or inſolubility in ſeveral menſtrua, as ſpirit of vinegar, ſpirit of wine, oil of tartar*, &c.

Different quantities of Caput mortuum *afforded by different mineral waters.*

'Tis ſurprizing to obſerve, how great an inequality there ſometimes is, in the proportion that the ſame quantity of two different mineral waters bears, to the *Caput mortuum* they reſpectively afford: ſince a pound, for inſtance, of one, may, after evaporation, leave behind it, perhaps, more drams of a dry ſubſtance, than a pound of the other leaves grains.

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Since, then, the marcaſite impregnated ſo much water with its groſs parts, obtain'd by a bare ſolution, it ſeems highly probable, that the ſame quantity of liquor may be impregnated by a far leſs quantity of mineral matter, attenuated by being rais'd in the form of fumes or exhalations: and, that imperfect or embryonated iron may be thus raiſed, appears from hence, that iron will manifeſtly emit copious fumes, without the help of external fire. And if it be with ſome ſuch ſpirituous and volatile exhalations, that a mineral water, as thoſe of *Tunbridge* and *Iſlington* is impregnated, 'tis eaſie to conceive how they may ſoon loſe their chief virtues by the avolation of their fine parts, upon their being removed to a diſtance from the ſpring-head. And to make it probable, that vitriolate corpuſcles may be made to aſcend without loſing their nature, I ſhall here mention an experiment that I deviſed, to give ſome light into this matter. I had often found, by tryal, that a ſpirit, richly impregnated with volatiliz'd ſulphur, wou'd, with vitriol, whether in the form of a powder, or a ſolution, produce, in a trice, a very dark or blackiſh colour: and gueſſing, that in mercury, turn'd, by the addition of ſalt and vitriol, into corroſive ſublimate, many of the vitriolate corpuſcles might aſcend with the mercurial ones, I drop'd a volatile ſulphureous tincture upon good ſublimate, and found it preſently turn to a very opake colour. To ſhew, alſo, that to make a great dilatation or diſperſion of the ferruginous corpuſcles of an ore or mineral, there needs no ſpirit of ſalt, or the like diſtill'd menſtruum; I procured, from a place where artificial vitriol is made, ſome of the liquor they employ before they caſt in iron, that being corroded thereby, it may increaſe the weight, and give ſolidity and ſome other qualities to the deſign'd vitriol. For tho' this liquor be made without any chymical menſtruum, barely by rain or ſnow-water, that impregnates it ſelf with ſaline or metalline particles, in its paſſage thro' beds of marcaſites, that lie expoſed to the ſun and air; yet in this water ſuch numbers of ferruginous corpuſcles are diſpers'd, that having let fall four drops of it into twelve ounces and a half of common water, this liquor, as I expected, was thereby ſo much impregnated, that, with powder of galls, it preſently produc'd as deep a colour as good *Tunbridge* water would have done. So that ſuppoſing a drop of this liquor to weigh about a grain, as by ſome tryals purpoſely made we found it did, we ſee that one part of the vitriolate water was able, manifeſtly, to impregnate fifteen hundred parts of common water. And yet, of theſe four drops or grains of the vitriolate liquor, a conſiderable part may very probably be concluded, from the way of its production, to have been rain-water; ſince, to examine this ſuppoſition, we ſlowly evaporated ſome ounces of that liquor, and found the remaining dry ſubſtance amounted not to the fourth part of the weight of the whole; whence 'twas eaſie to conclude, that one grain of vitriolate ſubſtance would have impregnated ſix thouſand times its weight of common water, ſo as to make it fit

to

to produce, with galls, a purple tincture. We afterwards found, upon a careful tryal, that the experiment will hold, tho' the proportion of the water, to the grain of tinging substance, shou'd exceed that above-mentioned by the weight of some hundreds of grains. MEDICINE.

28. *Whether, and how much, the earth of the mineral water loses by a strong and lasting ignition; what changes of colour,* &c. *it thence receives; whether it be, of it self, capable of vitrification; and what colour it will impart to fine pulveriz'd* Venice *glass, when exactly mix'd therewith, and flux'd into a transparent glass.*

29. *The œconomical and mechanical uses of the mineral water in brewing, baking, washing of linen, tanning, dying,* &c. *as these may, severally, assist in discovering the ingredients and qualities of the liquor.*

30. *How to imitate the natural medicinal waters, by chymical and other artificial means, in order to discover the quality and quantity of the ingredients that impregnate the same.*

To make a succedaneum for mineral waters, such as those of the *Spaw* or *Tunbridge*, we took one part of very good filings of iron, and ten parts of good distill'd vinegar. These were put into a bolt-head well stopt; and then, in a mild heat of sand, we digested them for about two days, and afterwards augmented the heat till the liquor appear'd of a deep orange colour, yet transparent. Part of this tincture we poured off, and kept well stop'd by it self; because, tho' by a longer digestion and a greater heat, we obtain'd a very red tincture, yet we did not so much value it, because, when the menstruum is too much impregnated, the metal usually precipitates, and the fine colour is destroyed. Of the first tincture we let fall four drops into eight ounces and an half of clear common water, whose colour was not thereby sensibly alter'd; and the vial, containing this mixture, being well shaken, that the tincture might diffuse it self the more thorowly, we kept it carefully stop'd for use, as being our factitious *Spaw* water. A spoonful or somewhat more of this, with about a quarter of a grain, or less, of good fresh powder of galls, would presently afford a purplish tincture, like that of natural springs impregnated with iron; and if the mouth were wash'd therewith, it appear'd to have, like those natural waters, a manifest ferruginous tast. But these artificial *Acidulæ* ought to be administer'd soon after they are made; for experience has informed me, that when kept too long, they lose much of their briskness and force. I sometimes here perceived, there would subside to the bottom, a certain reddish substance, as it were oker, which shew'd the degeneracy of the liquor: and some such thing I have observ'd in natural chalybeate waters, too long or negligently kept. *Artificial* Spaw *water.*

31. *Particulars omitted, but directly belonging to the history of mineral waters.*

32. *Miscellaneous observations and experiments, indirectly referable either to one or more of the specified heads, or to the common subject of them all.*

SECT. IV.

MEDICINE.

Heads for the natural history of a mineral water considered as a medicine.

WE come, in the last place, to give a set of heads for the history of a mineral water, consider'd as a medicine.

1. *To what tempers and constitutions the propos'd mineral water is the most proper, to what less proper, and to what noxious or inconvenient.*

2. *In what stated diseases and particular cases it is proper, or suspected to be dangerous, if not certainly hurtful.*

3. *What difference there is between the water taken up, and presently drunk at the spring it self, or other receptacle, and when carried to some distance from thence, whether in open or well clos'd vessels.*

4. *The manifest operations of the water in those who take it, whether by vomit, stool, urine, or by any two, or all of these ways together.*

5. *Whether any occult virtues are discoverable in the mineral water, and if any, what they are.*

6. *What difference in the effects of the mineral water proceeds from it being drunk, all of it, quite cold, or hot, or luke-warm, or one part when 'tis in one of these tempers, the rest when in another.*

7. *How to promote or facilitate the operation of the water in some, by taking it in bed, and in others, by moderate exercise.*

8. *What assistance may be afforded to the operation of the water, by giving with it, especially in the first draught, something to make it pass the better, to correct its crudity, or strengthen the stomach and* viscera.

9. *What advantages may accrue from preparing the patient's body before he enters upon his course of the waters; and what inconveniencies may attend the neglect of such preparation, especially in gross, foul, or much obstructed bodies.*

10. *The assistance the water may receive by gentle purging medicines, discreetly given at proper intervals.*

11. *The most proper dose or quantity of the water to be taken at once; the compass of time wherein it shou'd be all drunk; and the gradual encreasing and lessening the dose required at the beginning, and sometimes before the end of the whole time appointed for taking it.*

12. *How much the greater or lesser space of time, spent in taking water, conduces to its good effects; and what is the fittest measure of time to continue the drinking of it; respect being had to the patient's strength, disease, the time of the year, the accidental temperature of the air, and other considerable circumstances.*

13. *Whether the drinking of the mineral water, for several years together, be found necessary, or more beneficial, than to intermit it sometimes, for a year or two, or perhaps longer, and then to repeat the use of it.*

14. *The*

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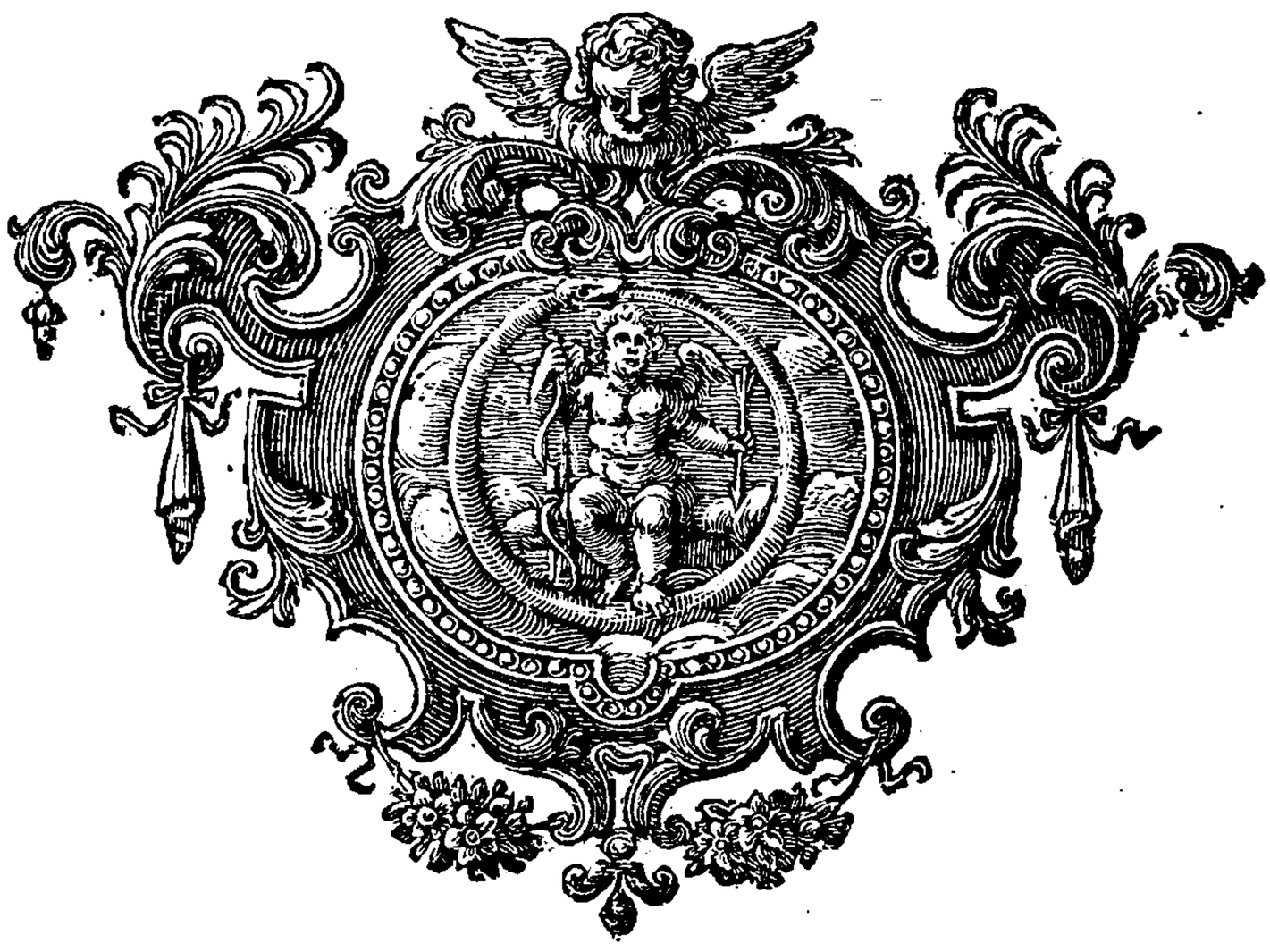
MEDICINE. with certainty, upon the nature, the medicinal operations, and other effects thereof, ſeems, till farther trials and enquiries have been made about them, a thing impoſſible.*

* That the nature and properties of mineral waters may change in time, or by accident, we have a remarkable inſtance in thoſe of *Paſſy* in *France*, which M. *du Clos* firſt examined, with great care; and, in a few years after M. *Lemery* coming to examine them again, found them quite different. See *Hiſt. de l' Acad.* A. 1701. p. 78.



CAUSES

CAUSES

OF THE

Wholſomneſs and Unwholeſomneſs

OF THE

AIR.

MEDICINE.

The healthy or unhealthy ſtate of the air, greatly depends upon ſubterraneal effluvia.

THE principal thing upon which the wholeſomneſs and unwholeſomneſs of the air depends, is the impregnation it receives from ſubterraneal effluvia. And, tho' this be a cauſe generally overlooked by phyſicians, yet 'tis often very conſiderable in its effects.

The effluvia that affect the air, may be diſtinguiſhed into ſeveral ſorts, according to their reſpective natures: but I ſhall now only take notice of the differences which may proceed from place and time. With regard to the former, ſome of them ariſe from the cruſt, or more ſuperficial parts of the earth; and others have a deeper origin, aſcending out of the lower parts, and bowels of the terraqueous globe. And in reſpect of the latter, ſome ſubterraneal effluvia are almoſt conſtantly ſent up into the air, which I therefore call ordinary emiſſions; and others aſcend but at certain times, diſtant from one another; and theſe I call extraordinary emiſſions; whether they come at ſtated ſeaſons, and ſo deſerve the title of periodical; or uncertainly, ſometimes with far greater, ſometimes with much ſmaller intervals; and ſo may be called fortuitous or irregular.

'Tis frequently obſerved, that marſhy grounds and wet ſoils, are unhealthful, becauſe of the moiſt and crude vapours, that the ſtagnating waters ſend up too plentifully into the air. On the other hand, dry ſoils are generally look'd upon as healthy. And, indeed, theſe obſervations ſeem moſt commonly to hold true: but, beſides what can be juſtly aſcribed to ſuch moiſt vapours, or dry exhalations, in many places

MEDICINE. the wholeſomneſs or unwhoieſomneſs of the air, may be aſcribed to other ſorts of effluvia, from the ſoil, than thoſe that act merely, or, perhaps, principally, either as moiſt or dry.

To deliver my thoughts the more diſtinctly upon this ſubject, I ſhall lay them down in four obſervations, or propoſitions.

PROP. I.

It ſeems probable, that in ſeveral places, the wholeſomneſs or unwholeſomneſs of the air, in the general, may be, in great meaſure, due to ſubterraneal expirations, eſpecially to thoſe I call ordinary emiſſions.

For, in ſome places the air is obſerved to be much more healthy, than the manifeſt qualities of it would make one expect: and, in many of theſe caſes, I ſee no cauſe, to which ſuch a happy conſtitution may more probably be aſcribed, than to friendly effluvia ſent up from the ſoil into the air; which particles, either by promoting perſpiration, or by hindering the production, or checking the activity of morbific ferments; or by mortifying and diſabling ſome noxious particles, that would otherwiſe infeſt the air, *&c.* may greatly contribute to keep the bodies of ſuch as live in that air, in the regular and deſirable ſtate, we call health. I know 'tis generally thought, that mineral bodies ſend up exhalations, hurtful to plants and animals; but when we ſpeak of ſubterraneal things indefinitely, we include more particulars than moſt men are aware of; there being a great number and variety of bodies, that nature has lodged in her ſtore-houſes under the ſurface of the earth. And of theſe differing ſorts, tho' 'tis probable the effluvia of the greateſt part are unhealthful to man, yet there may be others friendly to him. It has been obſerved, that over ſome tin-mines in the weſtern parts of *England*, not only trees, but far more tender plants, proſper and flouriſh; and I have ſeen verdent trees growing juſt over a vein of another ſort of mineral, that lay near the ſurface of the earth: 'tis likewiſe obſervable, of ſuch as conſtantly dig in thoſe tin-mines, that they arrive at a great and vigorous age. And an ancient poſſeſſor of ſome of theſe mines aſſured me, that tho' moſt of thoſe viſible fumes had a ſmell that participated of ſulphur, or bitumen, yet others were well-ſcented. I remember too, that a friend of mine, and another gentleman, being partners in a chargeable attempt to diſcover a mine; in digging deep for it, they accidentally broke into a vaſt ſubterraneal cavern; into which, becauſe the diggers would not venture, one of theſe gentlemen cauſed himſelf to be let down, and there found the air very temperate and refreſhing; ſo that he long breath'd it with delight: and on the ſoil he diſcovered many and various minerals, moſt of them embryonated, or imperfectly form'd; with plenty of a kind of mineral earth, whoſe ſmell was fragrant, and very pleaſant, both in his judgment, and that of ſome ladies. And,

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Continue

MEDICINE.

highly conduce to the wholeſomneſs of it. And the chymical examinations I have made of ſome boles, and other bodies, which are unregardedly comprized under the confus'd notion of earths, makes me ſuſpect, that there may be far more ſpecies of ſalubrious foſſils, than are yet taken notice of.

But it will appear the more probable, that ſubterraneal tracts of great extent, may, for a very long time, ſend up into the air, large expirations, not diſcernible by any of our ſenſes, from conſidering, that the common air wherein we live and breathe, always abounds, and, for many ages, has been impregnated with the plentiful magnetic effluvia of the earth, which our *Gilbert* and others, have proved to be a great, tho' languid magnet; and whoſe emanations, as they conſtantly ſtream thro' the air, are capable of paſſing thro' the pores of glaſs it ſelf, and acting almoſt inſtantaneouſly, yet manifeſtly, upon bodies hermetically ſealed up in it. But, tho' it may hence probably appear, that the wholeſomneſs of the air in ſome places, is chiefly, or at leaſt in part, due to the wholeſom expirations of ſubterraneal bodies; yet, generally ſpeaking, the air is depraved, in far more places than it is improved, by being impregnated with mineral expirations. And, indeed, among the minerals known to us, there are many more noxious, than wholeſom: and the power of the former to do miſchief, is far more efficacious than of the latter to do good; as we may gueſs by the ſmall benefit men receive in point of health, by the effluvia of any mineral, or other known foſſil, in compariſon of the great and ſudden damage that is often done by the expirations of orpiment, ſandarach, and white arſenic. The ingenious perſon, lately mentioned, told me, that when his guide and he walked over ſome veins of theſe noxious minerals, he met with ſeveral odorous ſteams, which, tho' differing from one another, agreed in being all offenſive to him; and, particularly, ſome of them by their ſharpneſs, and others by giving him a difficulty of reſpiration. We may here take notice of the *Averni*, ſaid to be found, ſome in *Hungary*, and ſome in other countries; where there aſcend out of the earth ſuch noxious and plentiful exhalations, as kill the animals that draw in the air they infect; and ſome of them are able to ſuffocate even the birds that fly over them. But there are numerous places, where 'tis leſs manifeſt that hurtful exhalations aſcend into the air. Whole tracts of land, near the ſurface of the earth, ſometimes abound with marcaſitical minerals, as theſe do with a ſharp vitriolic ſalt; which, together with the ill-condition'd ſulphur they alſo plentifully contain, aſcend into the air, and render it corroſive. I once took ſome *Engliſh* ſhining marcaſite, and caus'd a pound of it to be diſtill'd in an earthen veſſel, with a ſtrong fire; by which means, notwithſtanding its dryneſs, I obtained two or three ſpoons-full of a limpid liquor, that ſmell'd very ſtrongly, like *Gas ſulphuris*; and appear'd manifeſtly to be of an acid nature, both by the taſt, and by readily corroding, and diſſolving unbeaten coral, even in the cold. And the mine-

mineral afforded me, together with this liquor, about an ounce and three quarters of inflammable ſulphur ; part whereof, aſcending in the form of very agile corpuſcles, faſten'd themſelves all about the inſide of the receiver, and there compos'd ſeveral thin coats, or films, as 'twere, of ſulphureous matter ſticking to one another ; which, at their being firſt taken off, and for ſome time after, might be bent, or folded like leaves of paper, but afterwards harden'd in the air. Mineraliſts, and credible authors, mention ſeveral places as abounding with marcaſitical foſſils ; but I am apt to think, they are far more common than is vulgarly taken notice of : for I have met with them where one would little expect them. And, tho', in *England* all our vitriol be made of vitriolic ſtones, or bodies that paſs for ſtones ; yet that is not true. which our mineraliſts thence conclude, that there is no other vitriolic or marcaſitical matter in *England* ; for a famous dealer in foſſils, having found a mine, which he knew not what to make of, addreſſing himſelf to me, I diſcover'd it to be a vein, that lay at ſome depth under ground, and ran along like a vein of metalline ore, conſiſting of a black and heavy matter ; which, upon a few eaſie trials, I quickly found to be ſo far of a vitriolic nature, that, to my wonder, it yielded in a few hours, plenty of pure vitriol, without any troubleſome or artificial preparation. MEDICINE.

PROP. II.

It is probable, that, in ſeveral places, ſome endemical diſeaſes, principally, or at leaſt in part, depend upon ſubterraneal ſteams.

By endemical diſeaſes, I do not only mean ſuch as are very peculiar to this or that country ; as the *Plica* is ſaid to be to *Poland*, and therefore called *Polonica* ; or an odd kind of colic in one part of *France*, from whence 'tis termed *Colique de Poictou* ; but alſo thoſe that rage more in ſome countries than in moſt others, as agues in *Kent*, and in that part of *Eſſex* they call the *Hundreds* ; the conſumption in *England* ; and fluxes of the belly in *Ireland*, where they are ſo common, as to paſs under the name of the country diſeaſe.

That theſe endemical, or local diſtempers, in many places proceed from ſome exceſſive heat, moiſture, or other manifeſt quality of the air ; from bad diet, vulgar intemperance, and other cauſes that have little or no connexion with ſubterraneal reeks, I readily grant ; but, that in ſome places they may either be principally caus'd, or much fomented by noxious effluvia, I am inclin'd to ſuſpect.

For, 1. There are ſome places, in which the endemical diſeaſe cannot be probably imputed to any manifeſt cauſe ; ſince it often happens, that the cauſes aſſign'd of them, if they were true, muſt produce the like diſtempers in many other places, where yet it is notorious that they are not endemical.

2. Sub-

MEDICINE. 2. Subterraneal bodies may ſend up large ſteams, of different kinds, into the air.

3. The materials that ſend up theſe effluvia may be of a large extent. I have ſometimes obſerved, and that in more countries than one, a whole tract of land abounding with minerals of one kind; and at no great diſtance from it, another large tract, whoſe ſubterraneal part abounded with minerals of a very different ſort.

4. 'Tis, alſo, highly probable, from the nature of the thing, that thoſe large ſteams which impregnate the air, may greatly conduce to make it hurtful to a human body, in a way requiſite to produce a determinate diſeaſe. And, ſome parts of the ſubſtance of the air, not only affect human bodies, or, at leaſt, many individuals among them, as they are taken in by reſpiration, but as they outwardly touch the ſkin: and the ſkin being full of pores, perhaps of different ſizes and figures, thoſe corpuſcles that get in at them, may have their operation, even upon the moſt inward parts of the body.

'Tis obvious that I here take the air in its more vulgar and lax ſignification, for the atmoſphere, which abounds with vapours, exhalations, and, in a word, with corpuſcles of all ſorts, except the larger kind of ſpringy ones; and many of them may be ſo ſmall, and ſolid, or ſo conveniently ſhap'd as to enter ſome of the numerous orifices of the minute glandules of the ſkin, or at other pores of it. Thus, tho' paper be not pervious to the uncompreſs'd elaſtic parts of the air, yet it may be eaſily penetrated by other corpuſcles of the atmoſphere: for, I have prepared a dry body, out of a ſubſtance belonging to the animal kingdom, which being wrapp'd up in paper, would, without wetting or diſcolouring, or any way ſenſibly altering it, paſs in a trice thro' the pores of it in ſuch plenty, as to exert a manifeſt operation on bodies placed at ſome diſtance from it. And, tho' a bladder almoſt full of air, having its neck well tied, be held near the fire in various poſtures, the elaſtical air, tho' ratified, or attenuated by the heat, will rather burſt the bladder, than get out at its pores; yet we have often prepared a certain ſubſtance, belonging to the mineral kingdom, that, if a bladder were wet or moiſt, would readily pervade it, and have a ſenſible effect even upon ſolid bodies placed within it: yet the bladder of urine conſiſts not of a ſingle membrane, and is, probably, of a ſtronger texture, than many other membranes of the body, or the epidermis. But it may be ſaid, 'tis ſcarce conceivable, that in ſo many ages as endemical diſeaſes have afflicted ſome countries, the ſubterraneal matter, to which I, in great meaſure, impute ſome of them, ſhould not be ſpent and exhauſted. And, perhaps, indeed, ſome diſeaſes may have ceaſed, in places where they were once endemical; and others may have appeared in their ſtead. Tho' 'tis very poſſible, that many ſubterraneal bodies, which emit effluvia, may have in them a kind of propagative of ſelf-multiplying power; proceeding from ſome ſeminal principle, or ſomething ana-

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MEDICINE.

there is little doubt but they will impregnate them, and make them noxious.

But the effluvia of the lower parts of the earth, may have a greater ſhare in producing endemical diſeaſes, by mixing with the water, and other liquors, that are neceſſary to the nutrition and growth of vegetables, which may thence become unhealthy aliment. And theſe noxious exhalations will, probably, in many places, impregnate the juices of the earth, much more than running or ſtagnant waters; becauſe the difficulty of pervading the earth in their aſcent, may ſo long check them, as to render them very numerous in a ſmall ſpace; and, perhaps, make them convene into bodies, ſo far of a ſaline nature, as to be ſoluble either in common water, or ſome other ſubterraneal liquor; by means whereof, as vehicles, they may inſinuate themſelves into the roots of plants, and be thence conveyed to other parts. A famous chymiſt, who liv'd in a country abounding with mines of vitriol, told me, he obſerved, that the oaks growing over them were remarkably more ſolid and heavy, than thoſe trees elſewhere are. And the parts of ſome minerals are capable of inſinuating themſelves very plentifully into the pores of growing vegetables, without being really ſubdued, by what the philoſophers call the concocting faculty of the plant; whilſt, inſtead of being aſſimilated by the vegetable, they retain their own mineral nature; and upon the receſs, or evaporation of the juice that ſerved them for a vehicle, may ſometimes diſcover themſelves to the naked eye. For, I have ſeen a piece of a vine, that grew not far from *Paris*, which being broken, a multitude of the internal pores of the root, and part of the trunk alſo, appeared to be ſtuffed with corpuſcles of a marcaſitical nature; as was plain by their colour, their ſhining luſtre, and by their weight.

And ſince men feed not upon either beaſts, or birds of prey, but upon ſuch as eat graſs, ſeeds, or other vegetable ſubſtances, and drink nothing but water; the noxious exhalations that render vegetables and water unwholeſom, may, by that means, have a very bad influence upon ſuch animals, as are fed with ſuch depraved vegetables, and drink ſuch noxious waters; and, conſequently, may be very hurtful to thoſe men who eat ſuch animals; and, by the depraved aliment they afford, determine them to that endemical diſeaſe, which ſuch vitiated nutriment is fitted to produce.

'Tis poſſible, alſo, that in certain places the latent minerals may be of ſuch a nature, that their effluvia, inſtead of promoting, hinder the production of ſome particular diſeaſe, whether epidemical, or endemical, in the bodies of the inhabitants. For, as phyſicians obſerve, that the more manifeſt morbific cauſes of ſome diſtempers, are quite contrary to thoſe of others; ſo it ſeems not improbable, that there may, alſo, be a mutual contrariety between theſe latent morbific cauſes, ſent up by ſubterraneal agents. And, therefore, it's no wonder, if ſome of theſe ſhould either diſable ſuch to which they are hoſtile, or ſhould,

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at leaſt work in human bodies a great indiſpoſition to admit their hurtful operations. And ſince there are ſeveral whole countries, or leſs places, that are either altogether, or in great part, free from this or that particular diſeaſe; as ſeveral parts of *Scotland* from agues, eſpecially quartans; and as in ſeveral large regions of the *Eaſt-Indies*, the plague is very rare; it ſeems not improbable, that the ſubterraneal ſteams may contribute to this advantage, by impregnating the air, the earth, and the water, with corpuſcles of oppoſite qualities to theſe diſeaſes. And this ſeems the more credible, becauſe it has been obſerved, that ſome vaſt tracts of land will neither breed, nor maintain venomous creatures; as is undoubtedly believ'd of the whole kingdom of *Ireland*; where, I confeſs, I neither did ſee any alive, nor met with ſuch as had.

PROP. III.

Many epidemical diſeaſes are, probably, in great meaſure, produced by ſubterraneal effluvia.

It ſeems probable, that ſeveral of thoſe ſudden morbific exceſſes, that are obſerved in the air, may proceed from the unuſual quantity of hurtful exhalations, which aſcend and mix with the air, and diffuſe themſelves through it. We are great ſtrangers to the ſubterraneal part of the globe we inhabit; and there are a great many odd and ſurprizing things to be met with, in the ſtructure and diſpoſition even of thoſe parts of the earth, that lie but a little way beneath the ſurface of it. Whence it ſeems poſſible, that, among the many and various effluviating bodies, that the terreſtrial globe may conceal in its bowels, there are ſome, whoſe reeks, aſcending plentifully into the air, occaſion in it an acceſs of heat, cold, moiſture, thickneſs, or ſome other manifeſt quality. So that, ſometimes, even thoſe manifeſt intemperatures of the air, to which an epidemical diſeaſe is wholly imputed, may, in part, proceed from ſubterraneal bodies; for theſe, by their conflicts, or mutual actions on one another, may excite great and ſudden heats, and, on that account, ſend up ſuch large ſteams into the atmoſphere, as may there produce ſudden and exceſſive heats, lightnings, thunders, *&c.* And ſudden and unſeaſonable refrigerations of the air, may proceed from the action of ſubterraneal bodies upon one another; for trial, purpoſely made, has informed me, that there are certain minerals, whereof ſome may be employed in their crude ſimplicity, and others that require but a ſlight preparation, ſuch as may be had in the bowels of the earth, which being put together, will produce, by their reaction, an intenſe degree of actual cold.

The changes of the air which produce epidemical diſeaſes, are ſometimes ſo great and ſudden, that they cannot, in my opinion, with

MEDICINE.

probability, be imputed to the action of the ſun, or the moon; cauſes that act in too general and uniform a way, to produce thoſe particular and irregular effects; but to ſubterraneal bodies, whoſe actions are often more ſudden, impetuous, and irregular. The difference we find in ſeaſons, that bear the ſame name, and ſhould be alike in temperature, is often very great, and ſometimes, alſo, very laſting. But the ſun being in the ſame ſigns, at the ſame times of the year, it does not appear, how he ſhould produce ſo great a diſparity of the temperature of the air, in ſeaſons of the ſame denomination. And, doubtleſs, this variety is more rationally attributed to ſubterraneal exhalations, than to the influence of the fixed ſtars, which are ſo vaſtly remote from us; and ſeem too general a cauſe to produce ſuch particular effects as are often confined to a town, or ſome other narrow compaſs; whilſt ſubterraneal bodies are near at hand, of very various natures, and ſubject to many irregular and differing motions, commixtures, re-actions, and other alterations. I have known a great cold, in a day or two, invade multitudes in the ſame city, with violent and fatal ſymptoms; when I could not judge, that the bare coldneſs of the air could ſo ſuddenly produce a diſeaſe ſo epidemical and hurtful: and it appeared the more probable, that the cauſe came from under ground, becauſe it began with a very troubleſome fog.

That there may be many ſubterraneal bodies, which, by their mixtures, wou'd produce a ſudden heat, will be eaſily granted by thoſe who know, that there are ſubterraneal menſtruums; and have ſeen chymical operations, ſuch as the great effervеſcence, made, when oil of vitriol is put upon filings of iron, or ſpirit of nitre upon butter of antimony, *&c.* And as there is in many places vaſt plenty of marcaſitical matter, beneath the ſurface of the earth, and ſometimes very near it; I have purpoſely tried, that by putting a little ſpirit drawn from nitre, with which ſalt the earth in many places abounds, or a little oil of vitriol, upon powder'd marcaſites, there preſently enſued a ſtrong re-action between the liquid and the ſolid bodies, whereby was produced much heat, with viſible fumes, and ſtrong ſcented exhalations. And ſuch kind of odorous effluvia were emitted, after putting a little ſpirit of ſalt upon our powder'd marcaſites. And becauſe ſulphur is a mineral plentifully met with in the bowels of the earth, and in many places burns there; I ſhall add, that I have found acid ſpirit of ſulphur to work ſenſibly upon marcaſitical matter, hard coagulated. An experienced *German* chymiſt relates, that in ſome parts of his country, he met with vitriol-ſtones, or marcaſites, that, by the action of mere common water, reſting for a competent time upon them, will grow ſo hot, as to enable the liquor to retain a ſenſible heat, when it had paſs'd a pretty way from them. And, as many accidents may occaſion the breaking out of waters, or the change of their courſe in ſubterraneal places; ſo, that common water may, in a very ſhort time, produce conſiderable degrees of heat in mineral bodies, appears by

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MEDICINE.

the gold; ſo, the new corpuſcles produced in the air, whether attracted in reſpiration, or entering in at the pores, being carried up and down by the blood, or other fluids of the body, may paſs by ſome parts without doing them any ſenſible harm, and attacking others, there produce ſome diſeaſe, ſuch as the fabric and ſituation of the part peculiarly diſpoſe it to admit.

And this hypotheſis of ours well agrees with the very ſhort duration of ſome epidemical diſeaſes, in certain times and places. For either all the morbific expirations aſcended into the air at once, or, at leaſt, in a ſhort ſpace of time, and ſo were eaſily ſpent; that is, by being diffuſed or diſperſed, too much weakened to do any great miſchief; or elſe the ſubterraneal commotion that produced them may paſs on from one place to another, and ſo ceaſe to afford the air incumbent on the firſt place, the ſupplies neceſſary to keep it impregnated with noxious exhalations. Thus we ſometimes obſerve certain epidemical diſeaſes to have, as it were, a progreſſive motion, and leaving one town free, paſs on to another.

And as ſometimes an epidemical diſeaſe ceaſes in a particular place almoſt as ſuddenly as it invaded the ſame; ſo, according to our hypotheſis it may well happen, that after one ſort of exhalations, whoſe peculiar qualities make them morbific, have deprav'd the air over a particular place; there may, by a new or farther commotion of ſubterraneal bodies, be ſent up large expirations of another kind, which meeting with thoſe that formerly impregnated the air, may either precipitate them, and ſo free the air from them; or by other operations, and ſometimes even by coalitions, ſo alter their nature, as to diſable them from doing any farther miſchief.

Thus in that very remarkable phenomenon, yearly obſerv'd at *Grand Cairo*, it appears, that by the intermixture of adventitious corpuſcles with the peſtilential air, this is ſo alter'd and corrected, that within one day or two, there is a ſtop put to the progreſs of the plague, which, about the middle of ſummer, ſcarce ever fails to rage in that populous city. And theſe friendly corpuſcles operate ſo powerfully, that of thoſe who are already ſeiz'd by the plague, few or none die, after once the air is ſufficiently impregnated with them.

I confeſs ſo great and ſudden a change is very ſurprizing; and I ſhould ſcarce think it credible, had not ſeveral perſons, ſome of them very intelligent, who made a conſiderable ſtay in that city, aſſured me of the truth of it. And the lateſt writer of voyages into *Egypt* relates, that a little after the middle of our *June* (and uſually upon the very ſeventeenth day) there begin to fall, towards the laſt quarter of the night, certain drops of a kind of dew, which cauſes the river to be fruitful, and purifies the air from all infection. He adds, that "the dew purifies the "air; for as ſoon as it falls, the plague ceaſes to be mortal;" and, he ſays, "this dew gives life to every thing; and when it falls upon "the

" the wheat, cauſeth it to continue for many years without corrupti-
" on, or worms; and renders it far more nouriſhing than that corn on
" which it never falls. And, therefore, they never houſe the corn of
" the grand ſeignior till this dew is fallen upon it."

On the other hand, a very ingenious gentleman, who was owner of ſome mines in *Devonſhire*, told me, it ſometimes happens that, of a ſudden, a conſiderable tract of ground will be as 'twere blaſted by the aſcending fumes; ſo that not only the graſs, fern, and other more tender vegetables, will be turned black, and, as it were, burnt or ſcorched up; but now and then trees alſo, and even oaks themſelves, will be blaſted and ſpoiled by the powerful operation of theſe ſubtile and poiſonous effluvia.

The propagation, effects, and phenomena of the plague.

'Twill be expected I ſhould here take ſome particular notice of peſtilential fevers and the plague. The former, indeed, may probably ariſe from noxious effluvia of the earth: but as for the true plague, I am at a loſs for its origin; however, its propagation and effects ſeem chiefly to be carry'd on by a malignant diſpoſition in the air; without which, ſome plagues could never have been ſo contagious, nor ſo ſuddenly mortal: and that this malignant diſpoſition in the air, may, probably, be in great part imputed to ſome kinds of ſubterraneal expirations, I am apt to think, for the following reaſons.

And firſt, none of the ſeveral cauſes to which the plague is uſually imputed, ſeems ſufficient. The malevolent aſpects and influence of the celeſtial bodies ſuppoſe ſome things very difficult to be prov'd, and are agents too remote, too general, and too indeterminate, to be acquieſc'd in as the cauſes of ſuch particular ſymptoms and phenomena, as often accompany the peſtilence. And as for internal putrefaction, exceſſive heats, noiſome ſmells, corrupt aliments, *&c.* the learned *Diemerbroeck*, tho' his own hypotheſis ſeems to be more theological than philoſophical, has greatly weaken'd their force in this caſe.

But farther, by conſulting ſome uncommon authors, travellers, and navigators, I learn, that ſeveral great countries are uſually free from the plague; which, according to the vulgar hypotheſis, ought to be as much ſubject to it as others. *Leo Africanus* informs us, that ſome parts are ſo ſeldom afflicted with the plague, that it uſually ſpares the inhabitants for twenty-nine or thirty years together. And he expreſly records, that in *Numidia* it ſelf, notwithſtanding the raging heat of the climate, the plague is produc'd but once in a hundred years. Our *Purchas* informs us, that in the land of the *Negro*'s, it is not known at all. And, to omit what ſome travellers and navigators relate of *Japan*, as if it were ſeldom or never invaded by the peſtilence; I do not remember, that in *New-England*, which contains a great extent of land, that the *Engliſh* take any notice of the plague, ſince their firſt ſettling there. Sir *Philibert Vernatti* writes from *Batavia*, " that the plague is a " diſeaſe unknown to the *Indians*." And of the countries that lie yet more remote, as the great empire of *China*, and the kingdoms of

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MEDICINE. *Tunquin*, and of *Cochinchina*, *Alexander de Rhodes*, who ſpent thirty years in thoſe parts, affirms, that the plague is not ſo much as ſpoken of there; yet the ſame jeſuit, upon probable grounds, eſtimates the number of the people of *China* alone, to be two hundred and fifty millions; a number I take, by far, to exceed that of all the Nations of *Europe*.

Now conſidering what vaſt tracts of land are compriz'd in thoſe countries, ſome of which the plague does not at all, and others but very unfrequently, invade; we have a ſtrong argument againſt the generality of opinions received among phyſicians; as alſo that of *Diemerbroeck* himſelf, who derives the plagues from a ſupernatural cauſe, the provok'd wrath of God. For, in regions of ſuch extent, and many of them very populous, lying in different climates, and ſome of them inhabited by nations who make war with numerous armies, fight bloody battles, leave heaps of unburied bodies expoſed to the putrefying heat of the ſun, are ſometimes forc'd to live upon very unwholſom foods, who worſhip ſtocks, ſtones, beaſts, and ſome of them devils, who are, at leaſt, as guilty as *Europeans*, of aſſaſſinations, poiſonings, rapes, *&c.* in theſe regions: I ſay, 'tis not imaginable but that great intemperatures of the air, eſpecially in point of heat, ſtench of dead bodies kill'd in fights, unwholſomneſs of aliments, malevolent aſpects of celeſtial bodies, high provocations of the divine juſtice, and, in ſhort, all the cauſes, to one or other of which the ſeveral parties of phyſicians refer the plague, ſhould be wanting any more than in *Europe*; yet the plague, which is preſum'd to be the effect of one or other of thoſe cauſes, is not here obſerved to be produc'd.

If theſe hiſtorical facts be alledged, alſo, againſt our hypotheſis, I deſire it may be conſider'd, that my opinion about the plague conſiſts of two parts; one, that 'tis exceeding difficult to aſſign the true and adequate cauſe of its origin; and the other, that whatever be the cauſe of its firſt eruption; its propagation, and many of its ſymptoms, may be, probably, refer'd to the depravation of the air by ſubterraneal ſteams, and their effects; whence, theſe hiſtorical obſervations will appear to confirm the firſt member of our hypotheſis. And as to the ſecond; ſince in the *Eaſt-Indies*, and other countries, where the plague is not obſerved to break out, it cannot be pretended, that ſubterraneal effluvia there promote the propagation of it; no more can it be prov'd, that they could not, in caſe the plague were begun by other cauſes. 'But as I think it probable, that ſometimes the plague is not only fomented, but begun by noxious expirations of the terreſtrial globe, I ſhall add, that this ſuppoſition is not abſolutely inconſiſtent with the preceeding obſervations. For firſt, it may be ſaid, that ſome of the countries I ſpeak of, are deſtitute of thoſe noxious minerals to which we impute ſome plagues. Thus tho' ſulphur be uſually found in many countries, and that in plenty, where there are other metalline veins, yet in the mines of *England*, I never met with

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DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE. that the year, which of all in the memory of man, was all the world over the moſt immoderately hot, yet proved moſt healthful. And the ſame author reports the plague to have begun in the midſt of winter, and to have gone off in ſummer; and that, ſeveral times, ſcorching ſummers have been altogether free from the plague; which I, likewiſe, have obſerved to be true. *Johannes Morellus* tells us, that in his country, after a dry winter, wherein the north wind reign'd, tho' it were ſucceeded by a moſt temperate and healthful ſpring, yet this brought in the plague; and that too, when the north wind was predominant, and the air pure and ſerene. And I obſerved ſomething very like it, in the conſtitutions of the air, that preceded and accompanied the dreadful *London* plague in the year 1665. Now, theſe phenomena much diſcredit their opinion, who impute the plague to the exceſſes of the manifeſt qualities of the air; but are agreeable to our hypotheſis, ſince noxious ſubterraneal fumes may be ſuddenly, and without any warning, raiſed up into the air; and, by depraving it, produce fatal diſeaſes in many of thoſe perſons who are conſtantly ſurrounded by it, and draw it in, almoſt every moment, with their breath.

Of the deadly effect of ſeveral ſubterraneal expirations, at their firſt eruption, there are many hiſtories extant in approved authors: and we have obſerved inſtances of that ſort, in the times and countries we live in. But, becauſe all poiſonous, and even mortal exhalations, are not, therefore, truly peſtiferous, but may, like many other poiſons, kill the perſons they immediately invade, without qualifying them to infect others; I ſhall add a paſſage out of M. *de Mezeray*, who relates, that "the plague which happened in *France*, in the year 1346, was ſo "contagious, that ſcarce a village, or even a houſe, eſcaped uninfected "by it. This peſtilence," he ſays, "was the moſt furious and wide-"ſpreading that had been known, and began two years before in the "kingdom of *Cathay*, by a vapour moſt horribly fetid, that breaking "out of the earth, like a kind of ſubterraneal fire, conſumed and de-"voured above 200 leagues of that country, even to the very trees and "ſtones; and infected the air in a wonderful manner." He adds, that "from *Cathay*, it paſs'd into *Aſia* and *Greece*, thence into *Africa*, and "afterwards into *Europe*, which it ranſack'd throughout."

In the next place; there is a wonderful diverſity obſerved in ſeveral countries, and even in the ſame country, at different times of thoſe raging diſeaſes, that phyſicians call the plague; whence it happens, that ſuch medicines, or methods of cure, as are in one plague ſucceſsful, do often in another prove dangerous: which great variety may be fairly accounted for, by the great number and diverſity that has been actually found, or may be reaſonably ſuppos'd, in the numerous minerals, and other bodies, in the ſubterraneal regions; eſpecially if we conſider, that the number of ſuch bodies may be much increaſed and diverſified, by various combinations made of them by caſualties, ſubterraneal fires, and menſtruums. And the aſcending corpuſcles of thoſe

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mineral bodies, being moſt of them ſolid and ſubtile, may produce in the blood, and ſo in the body, far more odd and violent ſymptoms, than the peccant humours that beget ordinary diſeaſes. Which may be one reaſon, and perhaps the chief, why the ancients, and *Hippocrates* himſelf, acknowledged in peſtilential diſeaſes, ſomewhat of divine, ſurpaſſing ordinary nature.

What theſe mineral ſubſtances are, whoſe ſteams produce ſuch odd and diſmal ſymptoms, ſeems exceeding hard to determine. Yet, if I were to name one ſort, I ſhould think the leaſt unlikely to be orpiment. For, of the poiſonous minerals we are acquainted with, I know not any whereof there is a greater quantity in the bowels of the earth; many of whoſe miſchievous effects ſeem to agree with the ſymptoms of ſome plagues, and may be gueſſed to have, at leaſt, a conſiderable ſhare in producing them. Yet I do not think that theſe minerals are the cauſes, even of all thoſe peſtilences, whoſe efficients may be ſubterraneal: for ſeveral reaſons, and ſome drawn from experience, make it probable, that the ſubterraneal regions have many kinds of very pernicious foſſils, of which phyſicians, and even chymiſts, have no knowledge, nor diſtinct names; and that the various aſſociations of theſe, which nature may by fire and menſtrua make under ground, and, perhaps, in the air it ſelf, will very much increaſe the number and variety of noxious materials, and alſo heighten their hoſtility to human bodies. Thus, the factitious white arſenic, commonly ſold in ſhops, tho' uſually made of orpiment, by the addition of ſo innocent a body as common ſalt, (which is found in great plenty under ground) is obſerved to be far more poiſonous than orpiment it ſelf. And a ſkilful chymiſt, having in my preſence, taſted ſome prepared arſenic, was quickly invaded by ſuch ſymptoms, as he thought would ſoon kill him. But I preſently put him out of danger, tho' not out of pain, by early preſcribing him plenty of oil of ſweet almonds, and ſomething made of lemmons, that I chanced to have by me. And ſandarach ſeems to be but orpiment, whoſe yellow colour is deepned to redneſs; as native arſenic ſeems to be little other than pale or white orpiment. And, indeed, in *Hungary*, all three may be found not far from one another, in the ſame mine; as I learn'd from an eye-witneſs, by whoſe means, and thoſe of another chymiſt, ſeveral native orpimental minerals, (to ſay nothing of realgar, becauſe it is a factitious combination of orpiment and ſulphur) came to my hands. But tho' this ſort of foſſils are more numerous and various than is vulgarly obſerved, yet the very noxious effects of the effluvia of orpiment, are not unknown to phyſicians: and the learned *Sennertus* gives a particular inſtance of it in a painter, who, upon opening a box where orpiment, which men of his profeſſion uſe as a pigment, had been long kept, was thereby caſt into fainting fits, and had his face much ſwell'd. And, as white arſenic is of a more piercing and corroſive nature, ſo it were eaſy to ſhew, out of the writings of eminent phyſicians, that its effects have

MEDICINE. often proved very hurtful, and ſometimes mortal, tho' but externally worn in amulets; eſpecially if the pores of the ſkin were opened by exerciſe and ſweat. And the nature of the ſymptoms produced, ſeems to confirm our hypotheſis; ſince the perſons who wore theſe arſenical amulets were affected, ſome with great anxieties about the heart, ſome with inflammation, ſome with burning fevers, ſome with exulcerations of the breaſt, ſome with puſtules, like thoſe of the plague; and theſe were ſometimes black, as if made with a cauſtic. Moſt patients of this kind were affected with great weakneſs and faintneſs, *&c.* as if they had ſwallowed poiſon; and of one young man 'tis recorded, that having heated himſelf in a tennis-court, with an amulet upon his breaſt, the virulence of its corpuſcles made him fall down dead upon the ſpot. And 'tis a conſiderable circumſtance in theſe obſervations, that ſeveral patients were cur'd of the ſymptoms, that ſeem'd peſtilential, by the ſame remedies that are alexipharmic againſt the plague; whence it may, alſo, be made probable, that the plague it ſelf, many times, is a natural, tho' a dreadful and irregular diſeaſe; ſince its effects and ſymptoms ſo much reſemble thoſe of acknowledged poiſons, and have been cured by antidotes effectual againſt them.

An ingenious man, who ſometimes viſited a mine known to abound with orpimental foſſils, told me, that when he walked over the neighbouring grounds, he found himſelf much diſordered, eſpecially in his thorax, by the effluvia; and that the mine-men and diggers were ſubject to a malignant, irregular, and dangerous ſort of fevers; tho' he ſaid he was apt to impute it, in ſome meaſure, how truly I know not, to their drinking too much ſtrong wine. But, tho' 'tis probable, the effluvia of orpimental bodies may have a great intereſt in ſeveral plagues, yet, I ſtrongly ſuſpect, that many others may proceed from the ſteams of ſuch ſubterraneal bodies, as are not yet diſtinctly known to us; and, poſſibly, have their effluvia variouſly combined, either beneath, or above the ſurface of the earth. I have ſeveral times, and that without heat, combined fumes of differing kinds, ſeparately inviſible, into manifeſtly viſible ones, in the free and open air.

And that the ſubterraneal effluvia may produce effects, and, therefore, probably, be of natures very uncommon, irregular, and exorbitant, appears from thoſe prodigious croſſes that were ſeen in the year 1660. in the kingdom of *Naples*, after an eruption of *Veſuvius*. For theſe croſſes appear'd on linen that had lain open to the air; becauſe, as *Kircher* fairly conjectures, the mineral vapours were, by the texture of that, eaſily determined to run along in almoſt ſtrait lines, cutting each other; and, conſequently, to frame ſpots, reſembling ſome one, and ſome other kinds of croſſes. Theſe were extremely numerous in ſeveral parts of the kingdom of *Naples*; whence the jeſuit, who ſent the relation to *Kircher*, ſays, that he himſelf, found thirty in one altar-cloth; that fifteen were found upon the ſhift-ſleeve of a woman; and that he reckoned eight in a boy's band: Their colour and magnitude

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MEDICINE. a convenient vent, at which to diſcharge the matter that oppreſs'd her. This plaiſter was no other than the *Magnes arſenicalis* of *Angelus Sala*, mixt up with the warm gums. And if it prove as ſucceſsful in other plagues, as it did to thoſe who us'd it in that of *London*; there will be juſt cauſe to admire the providence, which, in a poiſonous mineral, that, probably, often concurs to produce the plague, has laid up a remedy for it.

An ancient and very experienc'd phyſician, to whoſe care a great peſt-houſe was committed, where, by the contagion, he loſt three phyſicians, his aſſiſtants, and three chirurgeons of four who were under him, told me, that his conſtant antidote was, only to take every morning, faſting, a little ſea-ſalt diſſolv'd in a few ſpoonfuls of fair water.

And a very learned phyſician, having once recommended to me an herb, little noted in *England*, as a moſt effectual and experienced antidote againſt the plague, I caus'd it to be cultivated in a garden, and when the peſtilence raged moſt ſeverely in *London*, I ſent ſome of it, made up with a little ſugar, in the form of a fine green conſerve, to two infected perſons, who, both of them recover'd. But having made only thoſe two tryals, I dare not relie much upon them; however, I uſually keep the plant growing in a garden, becauſe both the taſt and colour are pleaſant; and becauſe ſome little experience has invited me to believe the commendations I have found given of it againſt the bites of venemous creatures: about which there is a notable inſtance recorded by *P. Spehrerius*, of a *Roman*, who having, with his ſtaff, cruſh'd a viper that he took to be dead, had ſo ſtrong a venom tranſmitted along the ſtaff to him, that on the enſuing night, he found a very great inflammation in both his lips, which was followed by a vehement burning fever, and ſtrange torture; from all which he was ſtrangely relieved by the juice of goats-rue. It may without diſguſt be taken plentifully, in its entire ſubſtance, in the form of a ſalad, a conſerve, or a ſyrup, or elſe in its juice, newly expreſs'd.

It, likewiſe, agrees with our hypotheſis, that ſometimes the plague ceaſes, or at leaſt greatly abates of its contagion and malignity, in far leſs time than phyſicians could rationally expect. For ſometimes it may happen, that, tho' the conſtitution of the air continues the ſame, the matter that afforded the peſtiferous exhalations, may be either ſpent under ground, or altered by combination with other ſubterraneal bodies, or by ſome of thoſe many accidents that may happen, wholly unknown to us, in thoſe dark receſſes. And if once the fountain of theſe noxious effluvia be ſtopt, ſo that thoſe in the air ceaſe to be recruited; the wind and other cauſes may, in a ſhort time, diſſipate them; or at leaſt dilute them with innocent air, ſo far as to keep the diſeaſe, they produc'd, from being ſo miſchievous as before. And it may often happen, that, tho' the minerals which emit the hurtful

ful expirations, remain where they were under ground, and be not conſiderably waſted, yet their fatal effects may not be laſting; becauſe the effluvia were generated by the conflict of two or more of them, which vehemently agitated one another, and ſent up fumes, that ceas'd to aſcend, at leaſt in great plenty, when the conflict and agitation ceas'd. Thus, by putting good ſpirit of ſalt upon filings of ſteel or iron, in a convenient glaſs, a great conflict will be made between them; and without the help of external heat, there will be ſent up into the air large viſible fumes of a very ſulphureous odour, and eaſily inflammable; and this elevation of fumes will leſſen or ceaſe, as does the tumultuous agitation that produc'd them. So, likewiſe, if you pour *Aqua fortis* upon a convenient proportion of ſalt of tartar, there will, at firſt, be a great ebullition produc'd; and, whilſt that continues, great, red and noiſome fumes will be elevated, but not long outlaſt the commotion of the mixture, whoſe active parts ſoon combine into a kind of nitrous ſalt, wherein the noctious parts of the menſtruum are clog'd and hinder'd from evaporating or aſcending, tho' really they retain much of their priſtine nature.

It may, alſo, happen, that ſoon after the commotion of ſubterraneal matter, which yielded peſtiferous exhalatations, a more intenſe degree of ſubterraneal heat, or perhaps the ſame latent fire, extending it ſelf farther, may force up fumes of another ſort, that, being of a contrary nature, may prove antidotal to the former; and, by precipitating them, or combining with them, diſable them from acting ſo miſchievouſly as they otherwiſe would. I have ſometimes purpoſely made diſtillations, in which one part of the matter being, after the operation was ended, put to the other, there enſued a ſudden and manifeſt conflict between them, and ſometimes an intenſe degree of heat. And that mineral exhalations, tho' otherwiſe not wholeſom, may diſarm peſtiferous effluvia, appears from that obſervation of a country, which abounding with veins of cinnabar, was, probably, by their expirations, preſerved from the peſtilence. And our hypotheſis will, perhaps, appear the more probable, from the ſudden check that is almoſt every ſummer given to the plague, which at that time reigns at *Grand Cairo*. For, ſince 'tis generally obſerved, that morbific cauſes operate much more effectually than curative ones; it ſeems very probable, that exhalations aſcending from under ground into the atmoſphere, may be able to produce peſtilential fevers, and the plague it ſelf; ſince thoſe corpuſcles that impregnate the *Egyptian* air upon the ſwelling of the *Nile*, put a ſpeedy ſtop not only to the contagion, but to the malignity of the plague, aſſiſted even by the ſummers heat, which at *Grand Cairo* is exceſſive.

PROP.

The Air conſider'd,

PROP. IV.

'Tis very probable, that moſt of the diſeaſes, which even phyſicians call new, are caus'd, either principally, or ſecondarily, by ſubterraneal ſteams.

The term new diſeaſe, is much abuſed by the vulgar, who give that title to almoſt every fever, that, in autumn eſpecially, varies a little in its ſymptons, or other circumſtances, from the fevers of the foregoing year or ſeaſon. But by new diſeaſes, I mean only ſuch, whoſe ſymptoms are ſo uncommon, that phyſicians themſelves judge them to deſerve that appellation; ſuch, for inſtance, as the *Sudor Anglicus*, or ſweating ſickneſs; the rickets, and the *Lues Venerea*. But, perhaps, ſome diſeaſes, which, even among phyſicians, have paſs'd for new, were extant before, tho' not in the country wherein they are judg'd to be new.

But, taking it for granted, with the generality of phyſicians, that ſome new diſeaſes are to be admitted; I do not derive them wholly, or chiefly, from the varying influences of the heavenly bodies. For, the moſt powerful of thoſe, the ſun and moon, act in too general and indeterminate a way, to afford a ſufficient account of this matter. And as for the fix'd ſtars, beſides that they are univerſal and indefinite agents, it ſeems juſtly queſtionable, whether they have any ſenſible operation upon any part of our bodies, except our eyes. And, tho' I allow that great intemperatures of the air, as to the four qualities, heat, cold, dryneſs, and moiſture, may diſpoſe mens bodies to ſeveral great diſtempers; yet I cannot acquieſce in theſe, when I conſider how much more frequently they happen, than new diſeaſes; and that their action, tho' various, is too general and indeterminate to ſhew they can be the adequate cauſes of effects ſo rare and irregular, as diſeaſes odd enough to deſerve the title of new.

But, now, the ſubterraneal region of our globe is always near us, and abounds with variety of noxious minerals, and, probably, conceals great quantities of different ſorts of them. And ſince there want not cauſes in the bowels of the earth, to make great, irregular, and ſometimes ſudden confluxes, conflicts, diſſipations, and other conſiderable changes, amongſt the materials that nature has plentifully treaſured up in thoſe magazines; and ſince we have ſhewn, that the ſubterraneal parts of the globe may plentifully ſend up noctious effluvia of ſeveral kinds into the air; it ought not to ſeem improbable, that among this reſulting variety of foreign and noxious ſteams, ſome may be found capable to diſaffect human bodies, after a very uncommon way, and thereby produce new diſeaſes; whoſe duration may be greater or leſs, according to the laſtingneſs of thoſe ſubterraneal cauſes that produce them. On which account, it need be no wonder, that ſome new diſeaſes have but a ſhort duration, and vaniſh not long after they appear; the ſource or

fomes

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE.

If from good *Corniſh* tin, you warily diſtil an equal or double weight of *Venetian* ſublimate, into a very large receiver, very well luted on to the retort, you will obtain a ſpirituous liquor, which, as ſoon as the free air comes to touch it, will, very long, ſend up abundance of white exhalations in the form of a thick ſmoak: and tho' this liquor be thus apt to emit ſmoak, not only plentifully, but, as one would think, with violence, yet even when I put it into an open veſſel, if I did but lay a piece of a ſingle leaf of paper upon the orifice of the glaſs, ſo as to cover it all, the viſible production of the fumes would preſently ceaſe; and the liquor lie like common water, as long as the paper remained, tho' lightly upon the glaſs; but upon the removal of that, the liquor would ſend up plentiful fumes as before: which ſeems to argue, that ſome metalline ſubſtances may, by the contact of the air, have their copious aſcent into the atmoſphere very much help'd and promoted, as if the air had ſaline, or other ſort of particles in it, that, with regard to ſome mineral bodies, are of a very volatilizing nature.

We diſſolved copper in good *Aqua fortis*, till the menſtruum was ſatiated with it; in the ſtrong ſolution, we ſteep'd, for a while, ſome brown paper, that being fitter than the finer to ſoak up the liquor; then ſlowly evaporating the ſuperfluous moiſture, we put a quantity of this imperfectly dry'd paper upon the hearth, at ſuch a diſtance from a fire of actually flaming wood, that the paper was not kindled, yet ſo ſcorch'd as to afford very plentiful fumes; which looked like ordinary ſmoke, whilſt they moved through the air. But when the motion of the air towards the flame, had carried theſe fumes to it, they diſcloſed their nature; for, being actually kindled, they tinged the flame of a lovely colour, for the moſt part blue, and ſometimes green, as they happen'd to be variouſly mixed with the flame and ſmoke of the wood.

THE

THE NOTION OF Specific Remedies

Prov'd agreeable to

MECHANICAL PHILOSOPHY:

With the advantages of ſimple Medicines conſider'd, and their Uſe recommended

SECT. I.

MEDICINE.

THE ſpecific virtue of medicines, is an occult quality that well deſerves our conſideration. For, it not only excites our curioſity, and nearly concerns our health; but may, perhaps, prove of much greater importance than is commonly imagined. And an enquiry into this abſtruſe phenomenon, ſeems to me the more neceſſary, becauſe many learned phyſicians reject the mechanical philoſophy for being, as they fancy, irreconcileable to the notion of ſpecific remedies; or, at leaſt, unable to give any tolerable account of their operation.

Specific qualities, what.

I find three ſorts of qualities mentioned in the writings of phyſicians, under the notion of ſpecific virtues. By ſome of them a medicine is ſaid to have a ſpecific quality, becauſe it is eminently and peculiarly beneficial to a particular part of the body, as the heart, the brain, the eyes, &c. Others ſay, that a ſpecific remedy attracts and evacuates ſome determinate humour, as coler, phlegm, &c. But the moſt uſual

MEDICINE. account, upon which a medicine is ſaid to be ſpecific, is, that by ſome hidden property it cures this or that particular diſeaſe; as a pleuriſy, an aſthma, the colic, dropſy, &c. And this being the principal and moſt common ſenſe, wherein the word ſpecific is employed by phyſicians, I ſhall, hereafter, commonly make uſe of it in that ſenſe; yet without confining my ſelf ſo ſtrictly thereto, as not to conſider it in the other two, when occaſion ſhall require.

But, before I deſcend to particular conſiderations, I previouſly declare, that by a ſpecific medicine, I do not underſtand one that will cure a diſeaſe infallibly and univerſally; for, I confeſs, I never yet met with any ſuch remedy. Nor do I, by a ſpecific medicine, mean one that, like a charm, works only by ſome latent and unaccountable property, without the aſſiſtance of a known quality. But by ſpecific, I here denote a medicine, that moſt commonly, and better than ordinary means, gives conſiderable relief to the patient, by acting principally upon the account of ſome peculiar virtue; ſo that if it have any benign manifeſt quality, yet the ſervice it does is greater than can reaſonably be aſcribed to ſuch a degree of the manifeſt quality it poſſeſſes; whether it prove hot, cold, bitter, ſudorific, &c.

Whether there be really any ſpecific virtue in medicines.

Two grand queſtions may be propoſed, about the ſpecific virtues aſcribed to medicines; as firſt, whether they really exiſt; and, ſecondly, if they do, whether they can be mechanically accounted for.

The former of theſe queſtions admits of a double meaning; for it may be propos'd with reſpect either to the preſent meaſure of our knowledge, or to the future attainments of mankind.

In the latter ſenſe, I ſhall not maintain, without reſtriction, either part of the queſtion. For I am apt to think, that the future induſtry and ſagacity of men, will be able to diſcover intelligible cauſes of moſt of thoſe qualities, that now paſs for occult; and among the reſt of many ſpecific virtues aſcribed to medicines; yet, on the other ſide, poſterity will not be ſucceſsful in tracing out the true and immediate cauſes of thoſe good effects of ſome remedies, that depend upon too fine and uncommon textures, and too latent and irregular motions, to fall under the ſenſes, tho' aſſiſted by inſtruments. And this ſeems the leſs improbable, from conſidering thoſe ſtrange peculiarities of diſpoſition in the bodies of particular perſons, that are mentioned in the books of eminent writers. Some few of theſe, indeed, may be plauſibly accounted for; yet I do not think the like explications applicable to others.

As to the former ſenſe of the queſtion, I confeſs my ſelf very inclinable to the affirmative; as far as I can judge by ſuch writings of phyſicians, as I have peruſed. This limitation I add, becauſe I wou'd not derogate from the knowledge of particular perſons, who may have arrived at far greater attainments, than thoſe who have entertained the public about the occult and ſpecific qualities of medicines.

I know there have been, and ſtill are, dogmatical phyſicians, who, upon the principles of the ſchool-philoſophy, reject all medicinal virtues,

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MEDICINE. power, great enough, with the help of the ordinary concurrence of nature, to ſurmount the efficacy of the venomous matter. And, as perfumes often produce various, frightful ſymptoms, in hyſterical women; ſo the ſcent of burnt feathers do frequently remove them, in as little time as the ſweets produc'd them. And I have often found the ſmell of ſtrong ſpirit of hartſhorn, or of ſal-armoniac, recover ſuch women much more ſuddenly, than the fragrant odours gave the diſorder.

The third and principal inducement I have to allow of ſpecific remedies, is from experience. I might urge, on this occaſion, the teſtimony of *Galen*, who tells us more than once, that he himſelf, therefore, confided in the aſhes of burnt craw-fiſh, to cure the bite of a mad dog, becauſe never any of thoſe who took it died. And, by the way, he declares, that tho' the effect of theſe aſhes be admirable, even when given alone; yet their virtue may be increas'd, by adding to ten parts of them, five of gentian, and one of frankincenſe.

I here purpoſely forbear to mention ſuch medicines, as are by ſome learned phyſicians commended for ſpecifics, but queſtion'd or denied by others. It may ſuffice to take notice of two or three, whoſe efficacy is more notorious.

'Tis known, by daily experience, that in *Italy*, and other hot countries, tho' the ſtings of ſcorpions often produce very acute pains, and formidable ſymptoms, yet the miſchief is eaſily remedied, either by preſently cruſhing the body of the ſcorpion upon the hurt, or by anointing the part affected with oil of ſcorpions; which being made by ſuffocating thoſe inſects in common oil, and keeping it long in the ſun, the liquor does not appear to have any manifeſt quality, to which its ſanative efficacy may be aſcribed.

The bite of thoſe ſerpents, which, becauſe of the noiſe they make with a kind of empty bladders in their tails, we call rattle-ſnakes, are accounted much more poiſonous and dangerous than the ſting of ſcorpions. And yet when the *Engliſh* planters in *Virginia*, where they greatly abound, are bitten by theſe ſerpents, they very ſucceſsfully cure themſelves by the uſe of *Virginia* ſnake-weed.

That the *Peruvian* bark is a ſpecific againſt agues, particularly quartans, many learned phyſicians allow; and I remember, the famous Dr. *Willis* ſaid, in a private conference, "'tis the nobleſt medicine we know." But tho' I will not diſpute, whether it be ſo certain and ſafe a ſpecific for agues, as 'tis believed by ſome, yet it can ſcarce be deny'd to be a ſpecific medicine to ſtop the fits of agues; for it does that far more effectually, than the generality of phyſicians, for many ages, could with their other febrifuges.

I my ſelf have ſeen a ſtone, of ſurprizing efficacy in ſtopping hemorrhagies; and another which performed extraordinary things in more than one diſtemper; tho' I could not perceive that either of them acted by any manifeſt quality.

I know,

MEDICINE.

The reaſons urged againſt ſpecifics conſider'd.

I know, that thoſe who have rejected ſpecific medicines, confidently urged three plauſible arguments againſt them. Some phyſicians deny, that there are any effects of medicines ſo conſiderable, as to make them deſerve the name of ſpecific. Others would probably allow, that experience favours our opinion, did they not think the manner of a ſpecific's operation inexplicable, and therefore unworthy to be admitted by phyſicians. And, laſtly, others again will allow them to be very efficacious, but endeavour to derive their whole efficacy from manifeſt qualities, as heat, cold, tenuity of parts, the faculty of making large evacuations, *&c.*

But there is one argument that may be objected againſt ſpecific remedies, ſo ſpecious, as to deſerve a particular examination; leſt it ſhould, if unremoved, beget too ſtrong a prejudice againſt us. It may be ſaid, that a medicine taken in at the mouth, muſt in the ſtomach and inteſtins, be very much chang'd by digeſtion, and the aliment it meets with there; and a good part of it, be thrown off with the excrements; that, after it has paſs'd the ſtomach, it muſt meet with ſeveral ſtrainers of different textures, which will, probably, ſtop moſt of the medicinal particles that ſhould pervade them; and, that if any ſhall be ſo lucky, or ſo penetrating, as to ſurmount all theſe obſtacles, they will, probably, either be aſſimilated into the ſubſtance of the body, or be quite alter'd by the parts they muſt there combine with: or if any ſo obſtinately retain their priſtine nature, they will, in all likelihood, be too few to have a conſiderable operation upon the body. But to this plauſible objection, I have ſeveral particulars to oppoſe, by way of anſwer.

And firſt, many ſpecific medicines, as ointments, plaiſters, poultis's, amulets, pericarpia, *&c.* being outwardly apply'd; their particles may get into the maſs of blood, without paſſing through the ſtomach; and, conſequently, are not concerned in the preſent objection. (2) Againſt moſt of the *Galenical* phyſicians, who urge this objection, 'tis arguing *ad hominem*, to remind them, that the ſame, or as great difficulties, clog a common opinion of their own: for, ſince they ſuppoſe, that purgatives, cordials, diaphoretics, beſides cephalics, hepatics, *&c.* contemperate and ſweeten the blood, and uſefully affect the reſpective ſolid parts, to which they are adapted; and ſince theſe medicines act not by bare qualities, but by ſmall particles of their own ſubſtance; if they can give us an intelligible account of the admiſſion of particles, in conſiderable numbers, into the receſſes of the body, without being deprived of their particular virtues, they will, at the ſame time, inſtruct us how to anſwer the objection they urge againſt us. (3.) And, as the generality of phyſicians hold, that milk and urine were materially in the maſs of blood, and ſeparated from it by the breaſts and kidneys; I think the invalidity of their arguments againſt ſpecifics, appears from experience. For, 'tis obvious, that rhubarb tinges the urine of thoſe who take any conſiderable doſe of it. And in ſome of

our

MEDICINE. our *American* colonies, there grows a pleaſant red fruit, which the planters call the prickled-pear, whoſe juice is of ſo penetrating a nature, that it paſſes from the ſtomach into the bladder, and thence comes out with ſo little loſs of colour, that ſtrangers, who have eaten thereof, are ſurprized and frighted at their own urine; ſuppoſing it to be blood. As for milk, the great *Hippocrates* himſelf informs us, that if a woman, or a ſhe-goat, takes *Elaterium*, the cathartic virtue of it paſſes into that fluid, and purges the child who drinks it. And during my ſtay in the confines of *Switzerland* and *Savoy*, I obſerved, that when the cows in that diſtrict fed, as they uſually do in the middle of ſummer, upon a certain weed, ſaid to be a kind of wild garlic, the butter made of their milk had a very rank taſt of the herb. And I remember too, that paſſing a winter on the ſea-coaſt of the county of *Cork* in *Ireland*, I found it a known obſervation there, that a ſort of greedy ſea-fowl, living almoſt wholly upon fiſh, thereby acquired a taſt, that makes ſome pleaſantly queſtion, whether the food they afford be fleſh or fiſh. (4.) Laſtly, the objection that ſo ſmall a quantity of a ſpecific, as retains its nature when it arrives at the ſeat of its operation, muſt have little virtue left, will not ſtagger thoſe who know how unſafe it is to meaſure the power of natural agents, to work upon ſuch an engine as a human body, by their bulk, rather than by their ſubtilty and activity.

A ſober gentleman, who was governour of a colony in the torrid zone, and had ſailed far up the river *Gambra* in *Africa*, aſſured me, that the blacks had a poiſon, ſlow and mortal, the doſe whereof is ſo ſmall, that they uſually hide enough to kill a man under one of their nails; from whence they very dextrouſly convey it into any liquid aliment, for the perſon they deſign it. He added, that in another part of *Africa*, a famous knight, who commanded the *Engliſh* there, and lately died in his paſſage home, was in this manner poiſon'd by a young *Negro* woman of quality.

I could name a vegetable ſubſtance growing in *England*, which, tho' ſome empirics employ as a medicine, is ſo violent in its operation, that a learned and famous modern phyſician declares, half a grain would cauſe very dangerous hypercatharſes; which have ſometimes proved mortal.

And becauſe many ingenious men deny, that our *Engliſh* vipers are poiſonous; I ſhall add, in favour of the argument I have been enforcing, that I know a young man, who having been bitten by an *Engliſh* viper, which he raſhly took hold of, tho' the tooth only prick'd his hand; and the venom, convey'd by ſo ſmall a hurt, perhaps equall'd not, in quantity, the hundredth part of a pin's head; yet it quickly produced dreadful ſymptoms in him; and, among others, a violent vomiting. A perſon, alſo, whom I knew, that practiſed phyſic in the iſle of *Java*, where ſcorpions are held to be more venomous, having been ſtung in his thumb, by a ſcorpion, tho' the wound was ſo ſmall that I could not obſerve the leaſt ſcar it had left, it put him preſently to moſt exquiſite torture, which

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

But before I come upon this explanation, let it be obſerved, once for all, that I content my ſelf, on moſt occaſions, to give only poſſible explications; and to ſhew, that ſpecific medicines may operate in the manner I propoſe; without affirming that to be the very manner in particular caſes; becauſe we need not grant, that the operations of all ſpecifics, or of the ſame, in different diſeaſes, muſt be of one kind: for, different ſpecifics may operate in ſeveral manners; and ſome by one means may cure one diſeaſe, and others another. Nor need the ſpecific remedy always relieve the patient, by this or that ſingle manner of operating, but by a concurrence of two or more, that, as it were, join their forces to produce the deſired effect.

For a foundation to the following propoſitions, it muſt be remember'd, that an animated human body is not a mere ſtatue, or congeries, of the materials 'tis compos'd of; but an admirably fram'd engine, conſiſting of ſolid, liquid, and pneumatic ſubſtances, ſo exquiſitely adapted to their reſpective functions and uſes, that the effects of an agent upon it, are not commonly to be meaſured by the power of that agent, conſider'd in it ſelf, but by the effects conſequently produced from the action of the parts of the living machine upon one another.

PROP. I.

A ſpecific medicine may cure, by diſcuſſing or reſolving the morbific matter, and thereby fitting it for expulſion thro' the greater outlets of the body, and the cuticular pores.

'Tis known, that many obſtinate chronical diſeaſes often proceed from viſcid humours, that obſtruct the canals wherein the blood ſhould circulate, or other uſeful fluids be tranſmitted. And theſe peccant humours are often ſo tenacious and obſtinate, that ordinary remedies will have little effect upon them. But a ſpecific may, by the ſmallneſs and ſuitable figure of its corpuſcles, get thro' the pores into the receſſes of this ſtubborn matter; and thus, by their ſolidity, figure, and agitation, promoted by the heat of the patient's body, diſſolve and ruin the texture of the morbific matter, and render it capable of being naturally proſcribed by urine, ſweat, or ſome other commodious and innocent evacuation. Thus, the blood, or other fluid of the body, being impregnated with the benign and operative particles of the remedy, becomes an appropriated menſtruum to the peccant matter. Thus ſal-armoniac may be diluted into a menſtruum, that, by degrees, will diſſolve both copper and iron. The menſtruum, in this caſe, muſt be appropriated, becauſe there is no ſufficient reaſon to ſuppoſe, that it works by any manifeſt quality, as heat, moiſture, *&c.* or even by acidity: but rather, by virtue of the fitneſs, which the ſhape, bulk, ſolidity, and other mechanical properties of its particles, concur to give it, to ſhake aſunder the parts of a body of ſuch a determinate texture. For there are many more diſtinct

diſtinct ſorts of menſtrua than are commonly taken notice of; and the operations of theſe cannot ſafely be meaſured by the ſtrength of their manifeſt qualities; ſince it may often happen, that a menſtruum, leſs acid, or leſs ſtrongly taſted, may diſſolve this or that body, which another menſtruum, that ſeems far ſtronger, will not work on. Thus cold water will diſſolve the white of an egg, which pure ſpirit of wine, oil of vitriol, or ſpirit of ſalt, will coagulate. Thus rectified ſpirit of urine, will readily diſſolve minute filings of copper, which ſpirit of vinegar will but ſlowly corrode; and yet this liquor will ſpeedily diſſolve crabs eyes, which ſpirit of urine will leave entire. Thus quick-ſilver, that is inſipid, will, without heat, diſſolve gold, which *Aqua fortis* it ſelf, tho' aſſiſted by fire, will not touch; and yet *Aqua fortis* will furiouſly tear aſunder the parts of iron, tho' quick-ſilver will not ſo much as adhere to its ſurface. And thus, in ſhort, common oil, that is ſo ſmooth upon the tongue, and will not corrode ſo much as an egg-ſhell, will diſſolve brimſtone, which reſiſts *Aqua fortis* it ſelf, that diſſolves almoſt all metals, beſides many hard ſtones and minerals. And I have prepared a liquor, which, tho' ſo weak that one may ſafely drink a wine-glaſs full of it, pure, will yet operate on ſome very hard bodies, both ſtones and metals, in a way that is not to be match'd among the highly corroſive menſtrua uſed by chymiſts. MEDICINE.

And now, ſuppoſing that the active corpuſcles of a ſpecific medicine, aſſociated with the blood, or other vehicle, may act upon the morbific matter they meet with, in the manner of a menſtruum, we may illuſtrate ſeveral particulars with regard thereto.

And, firſt, we may hence conjecture, why an appropriated medicine will perform what another cannot; tho' its manifeſt qualities ſeem to be of the ſame kind, and much ſtronger in degree. For, menſtrua do not always act according to the degree of their acidity, or the like ſenſible quality, but according to the congruity of their parts, to the pores of the body they are to diſſolve; and frequently, alſo, according to a fitneſs that depends upon other mechanical properties of the acting liquor. And, therefore, phyſicians, as well as others, may eaſily miſtake, in arguing *à majori ad minus*, and *à minori ad majus*. For, becauſe water will diſſolve gum arabic, therefore that highly rectified ſpirit of wine, which is a much more ſubtile and penetrating liquor, muſt diſſolve gum arabic, is a falſe concluſion: or thus, becauſe ſtrong oil of vitriol is more corroſive to the taſt, and will diſſolve many bodies that *Aqua fortis* will not, therefore that it will diſſolve ſilver as well as *Aqua fortis*, is falſe, and the contrary true. Nay, this is not a juſt inference; *Aqua fortis* diſſolves ſilver by virtue of its acid ſpirits; therefore the more it abounds with theſe, the more powerfully will it diſſolve that metal: for, if *Aqua fortis* be made exceeding ſtrong, it will not work upon ſilver, but readily, after it has been weakned by the addition of a fit quantity of common water.

MEDICINE. To all this I might add, that the diſſolution of a body may depend, as well upon the peculiar texture of the body it ſelf, as the manifeſt ſtrength of the menſtruum.

2. This doctrine may ſuggeſt the reaſon, why a medicine, that has a great effect in one diſeaſe, proves ineffectual in another, apparently of kin to it, and perhaps leſs obſtinate. For, the preſumed analogy between them may not be ſo great, but that ſome diſſimilitude of texture in the morbific matters, may render the one unfit to be wrought upon, by the ſame menſtruum that diſſolves the other. Thus, tho' pure ſpirit of wine will eaſily diſſolve gum guaicum, and the little portions of reſinous matter that are harboured in the pores of the wood; yet the ſame menſtruum will not work upon the wood of the tree that affords theſe ſoluble ſubſtances.

3. This may keep it from appearing ſtrange, that ſpecific medicines ſhould ſometimes fail of their deſired effects. For, as the bodies of individual patients may greatly differ, either in their natural conſtitution, that they acquire by the diſeaſe, or in both; ſo 'tis not ſurprizing, that in ſome ſick perſons, among many, the congruity between the agent and patient ſhould be alter'd, either by a conſiderable change in the texture of the morbific matter, or ſome alteration that the corpuſcles of the medicine receive in their paſſage thro' the veſſels, by the admixture of ſome incongruous particles of the blood, or other vehicle. Thus both ſpirit of ſalt, and that of nitre, will diſſolve copper, and the latter ſilver; yet if you mix the other with ſpirit of ſalt, which, by its like operation upon copper, ſeems of the ſame nature, the ſpirit of nitre will be no longer able to diſſolve ſilver, as it would before.

4. Our hypotheſis may, alſo, hint an anſwer, to one of the chief and moſt plauſible objections produced againſt ſpecific medicines. 'Tis aſk'd, how a medicine can poſſibly rove up and down in the maſs of blood, and, neglecting whatever elſe it meets with, ſingle out and faſten upon the morbific matter to be proſcribed. Why, if the medicine acts by impregnating the blood, or ſome other fluid of the body, and turning it into a kind of menſtruum, 'tis very poſſible that the ſtrainers, thro' which the corpuſcles muſt paſs, may keep back the inconvenient parts of the vehicle; and, which is in our caſe more conſiderable, that the menſtruum may be either appropriated to the peccant humour; or elſe, at leaſt, be qualified to reſolve that more eaſily, than any other ſubſtance it meets with in the body. Thus if bone-aſhes, *Crocus martis*, ſaw-duſt, powder'd ſea-ſalt, and filings of gold, be blended all together; and afterwards divided into two parcels, and upon one you pour common water, it will readily diſſolve the ſalt, and leave the other ingredients untouch'd; and if upon the other part of the ſame mixture, you put a ſufficient quantity of quick-ſilver, and rub them together, this metalline liquor will only faſten upon the gold. And thoſe who work in the *Spaniſh* gold-mines inform us, that when they have well ground

ſome

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MEDICINE. be either quite cured, or greatly leſſen'd, by a ſpecific, that abounds in corpuſcles fitted to obtund acids. Now, ſuch an effect is producible by more ways than one, but the principal that now occur to my thoughts are theſe two.

Firſt, there are ſome bodies that mortify, or diſable acids, by a poſitive hoſtility, or ſuch a contrariety, as is diſcernible by the taſt, the viſible conflict, and manifeſt tumult produced when they invade each other. Such bodies are thoſe called alcalizate ſalts; whether fixed, as the lixiviate ſalts of plants, or volatile, as the ſpirits, and aſcending ſalts of urine, blood, hartſhorn, *&c.* as may be exemplify'd by mixing any of theſe with *Aqua fortis*, ſpirit of ſalt, oil of vitriol, or the like acid liquors. Whence, by the way, we may ſee, that thoſe *Galeniſts* miſtake, who aſcribe the virtues of ſpirit of hartſhorn, and of urine, only to their tenuity of parts, briſkneſs of motion, and the like properties; that they might not ſeem obliged to the chymiſts for ſo uſeful a notion, as that of the contrariety of acids and alkalies.

The other principal means by which acids may be mortified, is, by being ſheath'd; for an acid corpuſcle may loſe its power of cutting or pricking, either by having its figure ſpoiled by the action of a ſtrong and manifeſt alkali; or elſe by being cover'd in a porous body, that, perhaps, is endowed with no taſt, or any other manifeſt quality. Of this way of mortifying acids, chymical operations afford us many inſtances; as when minium deſtroys the acidity of ſpirit of vinegar, chalk that of *Aqua fortis*, and *Lapis Calaminaris* that of ſpirit of ſalt, and even of ſpirit of nitre. And I the rather mention *Lapis Calaminaris*, becauſe its qualities are leſs known to phyſicians, and the generality of chymiſts; and becauſe it ſupplies me with an argument, to prove that acids may be rather ſheathed than deſtroyed; by the bodies that ſilently mortify them. For, as *Glauber* juſtly obſerves, acid ſpirits may, by the force of fire in diſtillation, be driven out of that ſtone very much dephlegmed, and ſtronger than before.

I know it may be here objected, that the mortification of acids is performed by a manifeſt quality; and therefore proves nothing in favour of ſpecific medicines. But to this I anſwer, firſt, that the power of mortifying acids, by ſheathing them, or by abſorption, is none of thoſe qualities, whether firſt, ſecond, or third, that the *Galeniſts* allow in medicines; tho' their ſufficiency to cure diſeaſes, has been, and ſtill is urged by many, againſt the ſpecific virtues of remedies. Secondly, that it is an unhappy and dangerous miſtake, that ſo many learned modern phyſicians ſhould take it for granted, that if a medicine be endowed with a manifeſt quality, its good or ill effect may be aſcribed to that quality, whether it be acid or alkaline; for there is a conſiderable difference, as various trials have aſſured me, between one acid and another, and between one alkali and another: 'tis fit, therefore, to diſtinguiſh betwixt an acid, as merely ſuch, and the peculiar modification that may belong to that acid. Thus, tho' all acid menſtrua, that I know of, will, if they

they be well dephlegmed, diſſolve copper; yet *Aqua Regis*, that diſſolves not only copper, but gold, will not touch ſilver; as, on the other ſide, *Aqua fortis* will not, of it ſelf, diſſolve gold; but if you give it a new modification, by adding to it common ſpirit of ſalt, which, as I have often found, leaves that metal entire, the *Aqua fortis* will eaſily diſſolve it. Nay, a different modification may not only cauſe a difference between acids, but what would commonly be called a contrariety; for ſpirit of ſalt will precipitate ſilver, which *Aqua fortis* has diſſolv'd; and ſpirit of nitre not only precipitates an antimonial powder out of that odd ſubſtance, butter of antimony, but does it with a ſurprizing conflict, tumult, and effervеſcence; yet this butter of antimony is ſo highly acid, that a little quantity of it turns a conſiderable one of water ſo ſour, that many chymiſts call ſuch a mixture *Acetum Philoſophorum*.

To apply all this to the propos'd objection; I at firſt plainly intimated, that a ſpecific medicine might ſometimes operate, in part, by a manifeſt quality, tho' the good effect it produced, were not due, barely to the kind or degree of that manifeſt quality, but to ſomewhat ſuperadded, upon which its ſpecific virtue, in a particular diſeaſe, depends. And, accordingly, it may be ſaid, that as there are ſeveral kinds of acids and alkalies, too, 'tis not every acid that will be mortified by every alkali, and thereby have its effects deſtroyed; which may be illuſtrated from hence, that tho' when copper as diſſolved in *Aqua fortis*, 'tis poſſible, by the help of mere chalk, ſkilfully applied, to make the menſtruum let go the corpuſcles of the metal; yet if, upon ſuch a high colour'd ſolution of copper, you ſhall pour a due quantity of ſpirit of urine, or the like volatile alkali, tho' there will preſently enſue a great conflict, and manifeſt ebullition, with noiſe and numberleſs bubbles, yet between theſe hoſtile ſalts, a multitude of the acid corpuſcles of the *Aqua fortis* will not be ſo mortified, as to let go the metal; but the ſolution, varying its colour, will acquire a deeper than before.

And when I conſider the differences to be found between vinegar, alum, cryſtals of tartar, juice of lemmons, juice of barberries, the eſſential ſalts of ſour plants, *&c.* I am apt to think, that nature, in diſorder, may produce, in a diſeaſed body, acids of ſeveral ſorts, which are not particularly known to us; and that ſome of theſe may have ſuch a peculiar diſpoſition, that our common alkalies will prove unable to diſſolve them; which yet may be conquer'd by ſheathing them with ſome appropriated, or peculiarly modified corpuſcles of a ſpecific remedy. This may be illuſtrated from hence, that tho' neither ſpirit of vinegar, ſpirit of ſalt, nor oil of vitriol, would, as far as I have try'd, diſſolve a ſtone taken out of a man's body; yet ſpirit of nitre, which leaves untouch'd ſome bodies that oil of vitriol will diſſolve, would readily work upon it, and thereby loſe its corroſiveneſs.

MEDICINE.

There are two things that I would have remarked, before I leave this ſubject. One of them is, that preternatural acids not only diſaffect the body, whilſt they continue ſenſibly acid; but in many caſes create diſtempers, whereof moſt men would think them the remedies. For, tho' acids be reputed to have an inciſive and reſolutive virtue, and are, therefore, preſcribed to cut tough phlegm, and to diſſolve coagulated blood; yet, as I readily grant this virtue to acids in ſome caſes, ſo there are others, wherein I greatly ſuſpect, that obſtructions, and their conſequent diſeaſes, may be occaſioned by the ſame; as they coagulate ſome fluids in the body, which are thereby rendred unfit to paſs with the reſt of the blood, thro' the ſmaller veſſels and ſtrainers of it. This I ſhall exemplify by the coagulation produced, by adding ſpirit of ſalt to the white of an egg, reduced to an aqueous conſiſtence; and the like may be eaſily effected in milk, which not only ſpeedily curdles with ſpirit of ſalt, but, as is vulgarly known, with runnet, juice of lemmons, &c. And experiments, purpoſely made, have ſhewn, that if ſome acids be conveyed immediately into the maſs of blood, they will coagulate that fluid it ſelf, whilſt it continues in the veſſels of living animals.

The other particular I deſire ſhould be here obſerved, is, that tho' acid corpuſcles are, by ſome modern phyſicians and chymiſts, ſuppos'd hurtful, both in the blood, and ſeveral ſolid parts of the body; and tho' ſome ingenious men impute almoſt all diſeaſes to the bad effects of acids; yet I am very inclinable to think, that many diſeaſes and ill ſymptoms proceed from corpuſcles, that, whether of a ſaline nature, or not, differ from acids properly ſo called. For bodies may, as 'twere, reſult from the combination of acids with other ſaline particles, that much alter their nature. Thus, ſpirit of ſalt will, with ſpirit of urine, compoſe a kind of ſal-armoniac; and ſpirit of nitre, with ſalt of tartar diſſolv'd in common water, will con-coagulate into ſalt-petre, or a body exceedingly like it; and the ſame ſpirit of nitre, or *Aqua fortis*, with ſpirit of urine, or of blood, or the like, will afford a very fuſible ſalt, very different from either of the ingredients, before their conjunction. And 'tis vulgarly known, that oil of vitriol, and oil of tartar *per deliquium*, produce, by their coalition, *Tartarum vitriolatum*; in which, both the acid and the alkali are very much infringed; the third body produced greatly differing from either of the liquors. And conſidering how many different ſorts of corpuſcles nature may have form'd, that, without being acid, may yet have notable and pernicious effects upon the blood, or ſome particular ſolid of the body; it ſeems probable, that other qualities are required, to mortify or diſable theſe morbific corpuſcles, than a contrariety to acid ſalts; and, conſequently, that a medicine, whoſe parts are peculiarly fitted to correct, or enervate a particular ſort that is noxious, may deſerve the name of a ſpecific.

But

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE. tation; as may be exemplified in certain quantities of ſpirit of ſal-armoniac, made with ſalt of tartar, or pot-aſhes, and ſpirit of nitre, or *Aqua fortis*; and alſo by ſpirit of urine, and ſpirit of ſalt, mix'd in a certain proportion; whereby they convene into corpuſcles, for the making of ſal-armoniac, which the phlegm of thoſe liquors will keep ſwimming. But, what makes moſt for my preſent purpoſe, there may be precipitations, where no tumult, or contrariety, appears; as when ſilver, being diſſolv'd in *Aqua fortis*, and the menſtruum diluted with 30 or 40 parts of diſtill'd water, if clean plates of copper be immers'd in the ſolution, the ſilver will be very ſlowly precipitated out of it, in the form, not of a calx, conſiſting of metalline and ſaline parts incorporated together, but in the form of pure ſhining ſcales of ſilver, almoſt like the white and glittering ſcales of ſome ſmall fiſh. There is, alſo, a way, by which I have brought diſſolv'd gold to ſettle about a body ſuſpended in its ſolution, in the form of a fine, and a high-colour'd calx of pure gold. But you may have an inſtance of ſilent precipitation, by rubbing a little, either of *Roman* or *Dantzic* vitriol, upon a newly whetted blade of a knife, moiſten'd with water; for the ſteel will thus immediately be overlaid with a reddiſh ſubſtance, which, by its colour, and other ſigns, appears to be manifeſtly cupreous. And 'tis not only out of ſolutions, made with acids, that bodies may be thus precipitated; for, upon ſearch, I have found, that there are, in nature, precipitants capable of ſilently precipitating ſome bodies, diſſolv'd in urinous, or other, not acid, menſtrua. It may, indeed, be juſtly ſuſpected, that ſuch precipitations are dangerous, by producing heterogeneous corpuſcles in the blood, that may prove too heavy, or groſs, to be evacuated. And I look upon this as a ſuſpicion to ſatisfy which 'twere fit to conſult experience; but, in the mean time, it may be repreſented,

1. That tho' ſome inconveniencies may happen from the bulk of the precipitated corpuſcles, yet this may be much inferior to the danger threatned by the over-active, and hoſtile particles, that produced, or fomented the diſeaſe.

2. That 'tis not neceſſary all concretions ſhould conſiſt of corpuſcles, too large to be thrown out at the maſs of blood; for, we ſee, that ſtony matter, which, as the chymical analyſis of it ſhews, is of a very compound nature, may be carry'd to all parts of the body. I knew a lady, who had a ſtone taken out of the lower part of her tongue. And phyſicians, who preſcribe large quantities of mineral waters, impregnated with iron, as I found thoſe of *Tunbridge* to be, and with ſulphur, ſuch as ſome of the *Bath* waters uſually are, build their expectations of a cure from them, upon a ſuppoſition that they are carried into the maſs of blood, and innermoſt parts of the body.

3. That yet precipitations may, poſſibly, be made of matter, contain'd in the blood, by medicines that do not get into the maſs of it. Phyſicians, ſometimes, give crude ſteel in ſubſtance, as well as prepared, to obtund the acidities of the blood, tho' the metalline corpuſcles, in

all

all probability, do not paſs into the maſs of that fluid, but are wrought upon by the matter, that, in its circulation, is thrown into the ſtomach and guts; which appear to be the ſeat of the operation of chalybeates, from the blackneſs they give to the excrements of the lower belly: but if they will have it, that prepared ſteel, for inſtance, calcin'd with ſulphur, paſſes thro' the pores of the inteſtines, or the fine lacteal veſſels, into the maſs of blood; 'twill be obvious to demand, why nature ſhould not be able to expel precipitated corpuſcles, at the ſame orifices, where ſuch compounded concretions as thoſe of ſulphur and that metal can enter. MEDICINE.

4. That it may, with ſome appearance of reaſon, be ſaid, experience has already been conſulted about the expediency of employing precipitating medicines. For, not to urge that the learned *Sennertus* ſeems to intimate, that ſometimes the febrile matter may be precipitated out of the blood; *Kergerus* very ſolemnly declares, that, in the ſpace of fourteen years, he cured above a thouſand of fevers, without bleeding, purging, ſweating, *&c.* by a ſingle precipitating remedy, and that univerſally, with all imaginable eaſe and ſafety. I endeavour'd, indeed, to obtain from *Germany* a confirmation of this matter of fact, but did not receive it; I find, however, that one of the emperor's phyſicians, declares himſelf inclin'd to believe it true.

But I can more eaſily ſuppoſe, that great, and deſireable changes may be wrought in the fluid parts of the body by appropriated precipitants, if it be true, as it is unanimouſly taught by a multitude of phyſicians, that many diſeaſes are cauſed by a putrefaction of the blood, and other animal fluids. For there is, in nature, a certain ſubſtance, or medicinal liquor, ſo powerful an enemy to putrefaction, that when a few grains, or drops of it, were put into a conſiderable quantity of water, that had been kept till it ſtunk as ſtrong, and offenſively, as carrion, (tho' it ſtill remain'd tranſparent) and diffuſed, by agitation, through it, precipitated therein a very ſmall and light feculency, which being remov'd, the remaining liquor was quite freed from all ill ſcent; nor did I obſerve, that the feculency it ſelf retain'd any. And, which is ſurprizing, all this was done in a very few minutes, by a very ſmall proportion of a precipitant, whoſe taſt was not at all either bitter, or acid, or urinous, or lixivious; which are circumſtances that may afford conſiderable hints to ſagacious inquirers.

PROP. IV.

The ſpecific may peculiarly ſtrengthen and cheriſh the heat; and, by that means, relieve the part affected.

This obſervation can ſcarce be made good, without entering into that important and perplexed controverſy, whether any medicines have a ſympathy with the head, heart, liver, *&c.* and, upon that account,

MEDICINE. deſerve the name of cephalic cordial, hepatick, *&c.* or to ſpeak more clearly, whether there be any medicines, that, in a particular manner, do good to this or that particular internal part of the body. In this diſpute the affirmative has been held, tho' I doubt upon ſlender grounds, in moſt of the phyſical ſchools, for ſeveral ages. But, in our times, many maintain the negative, and even deride the opinion they have forſaken. Some of them object, in a triumphant ſtile, that 'tis ridiculous to fancy ſuch a ſympathy betwixt a dead medicine and the parts of a living body; as if a phyſician could ſend a drug of an errand, to ſingle out a particular part among a multitude of others, and do it good offices.

But, notwithſtanding this, I think it very poſſible, that a medicine may ſo far reſpect a particular part, as tho' not to prove beneficial to that only, yet to be ſerviceable to it in a particular manner or degree: and this, I conceive, may happen upon one, or more, of the following accounts.

And, 1. when I conſider, that the firm parts of the body, as the heart, brain, liver, kidneys, *&c.* have each its particular ſtructure, wherein it differs from another; and probably the fluids alſo, as the blood, gall, lympha, *&c.* have their ſeveral textures; it ſeems probable to me, that the corpuſcles of a medicine, diſſolv'd in the ſtomach, and carry'd round by the liquors of the body, may, according to their determinate ſhape, ſize, ſtiffneſs, flexibility, motion, *&c.* be much more fit to lodge in one part of the body than the reſt, and, thereby aſſociating with its fibres, ſupply it with ſuch congruous particles as it either wants, or may prove beneficial to it, by re-eſtabliſhing or ſtrengthening its tone. And by this corroboration, the part may be enabled to reſiſt the hoſtilities of morbific matter, which phyſicians frequently obſerve to be thrown by the more vigorous parts upon ſuch as are weak or diſtempered; as is manifeſt in perſons ſubject to the gout, in whom peccant humours are very apt, upon ſeveral occaſions, to be tranſlated from the nobler parts; if thoſe be robuſt, upon the debilitated joints: on which ſcore, the gout, if it be well managed, is not, without reaſon, thought conducive to long life. Thus I knew a phyſician, who had ſuch a peculiar indiſpoſition in his jaw, that tho' he could uſe wines of ſeveral ſorts, without inconvenience, yet the drinking of a very little brandy, would ſoon give him the tooth-ach.

But I proceed to ſhew and illuſtrate, how the fitneſs of ſome medicinal corpuſcles, may enable them to aſſociate with thoſe of the part they are to affect. We ſee, from what happens in nutrition, eſpecially in that of ſucking children, that a ſingle aliment, as milk, affords, beſides various excrements, ſuch as the groſſer feces of the guts, and the more fluid ones of the bladder, the noſe, the cuticular pores, *&c.* a great number of corpuſcles that are detained and aſſimilated by parts of different ſtructures, as the brain, the heart, the bones, *&c.* ſince, otherwiſe, the

parts

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MEDICINE.

expel the ſand, gravel, ſmall ſtones, and other excrementitious matter, that before moleſted it.

And hence we may anſwer an objection, formerly mentioned againſt ſpecific medicines. For here we have a medicine, tho' a dangerous one, whoſe corpuſcles are ſo peculiarly adapted to the bladder, and urinary organs, that tho' when got into the maſs of blood, they are carried by it indiſcriminately to all parts of the body; yet often, without manifeſtly diſordering the reſt, they exceedingly affect and irritate the bladder alone. It may here be objected, that the firſt of our three ways, in which we ſay a particular part may be aſſiſted by a ſpecific, ſeems contrary to the ſecond; the former tending to corroborate, and the latter to relax and irritate it. But I anſwer, that ſince the part may be ſometimes in a natural, and ſometimes in a preter-natural ſtate; in the former a medicine will deſerve to be call'd appropriate, from keeping it ſound, which is moſt properly done by ſtrengthening it; and in the latter, merit the title of a ſpecific, becauſe it helps to reſtore it to a ſtate of ſoundneſs. And, again; tho' to effect this recovery, 'tis often very expedient, that the medicine procure an evacuation of ſome peccant matter, yet that evacuation is frequently much promoted and facilitated, by ſtrengthening the part, ſo as to enable it to diſburben it ſelf. And the ſame medicine may contain and communicate to the blood, corpuſcles of ſuch different ſhapes, ſizes, motions, *&c.* as ſucceſſively to relieve the part by both theſe means. Thus, phyſicians obſerve, that rhubarb not only purges the liver of choler, by its fine, laxative parts, but by its more earthy, aſtringent corpuſcles, ſtrengthens the tone of that part. I might add, that, in ſome caſes, this very corroboration of a diſtemper'd part may reſtore it to ſoundneſs; there being ſome diſeaſes of ſuch a nature, that they could not ſubſiſt in the affected part, unleſs thro' its debility, and the conſequences thereof, it were ſubject to admit, from time to time, freſh recruits of peccant matter to foment the diſorder. And, in ſuch diſtempers, if the ſtructure and tone of the part be re-eſtabliſhed by the operation of the ſpecific, its acquired vigour will enable it to reſiſt the entrance of new ſupplies of peccant matter, and to return them into the maſs of blood, to be thence diſcharged by the common ſhores of the body. In the mean time, nature will be able, by degrees, to ſubdue, diſſipate, or otherwiſe diſpoſe of that litttle portion of morbific matter that was lodg'd in the diſeaſed part.

We have not hitherto produced any example of the peculiar reſpect of a ſpecific, to a determinate, diſaffected part, apparently ſo incredible, as that a heavy, ſtony ſubſtance, being in ſmall quantity, taken at the mouth, ſhould manifeſtly contribute to the cure of a broken bone, in the extreme parts of the body; yet, not to urge the teſtimony of chymical writers, I remember a *German* phyſician, who was famous for great cures, related wonders of that ſtone called *Oſteocolla*, eſpecially if improved by a ſkilful preparation, which he communicated to me.

But without preparation, the judicious *Hildanus* greatly commends it, upon his own obſervation, for very ſuddenly breeding a callus in fractures. MEDICINE.

PROP. V.

A ſpecific may have its effect, by producing in the maſs of blood a diſpoſition to enable nature, by correcting, expelling, &c. to ſurmount the cauſe of the diſeaſe.

Whoever narrowly conſiders the practice of the moſt ſucceſsful modern phyſicians, will find that their preſcriptions are, in general, founded upon a ſuppoſition, that a great part of diſeaſes depend chiefly upon the vitiated conſtitution of the blood, and their cure upon reſtoring that fluid to a ſound ſtate.

Now this advantageous change of the blood may be effected by a ſpecific, ſeveral ways; and, particularly, firſt, by furniſhing the blood with ſome ſort of active corpuſcles, neceſſary to ferment it, or excite an uſeful commotion, or agitation therein. I do not here deſign to examine, whether the maſs of blood, contained within the veſſels of a living man, is capable of a ſtrict and proper fermentation; and therefore I have employed the word commotion, for ſuch as diſlike the other.

But as fermentation is become a general term, I ſhall not ſcruple to uſe it, after having premiſed, that becauſe many modern phyſicians, eſpecially ſince the learned Dr. *Willis*'s notions came to be in requeſt, have ſuppoſed fevers and agues to conſiſt in vitious fermentations of the blood; to diſtinguiſh the fermentation I here mean, from theirs, I call it uſeful.

Since, probably, then, there is often a vitious fermentation of the blood, there may alſo ſometimes be a want of fermentation, or a certain ſluggiſhneſs; upon whoſe account, either the briſk, inteſtine agitation, that fluid ought to have in healthful perſons, or a due quickneſs of circulation is wanting; upon which ſluggiſh ſtate of the blood, if it prove obſtinate and laſting, ſeveral diſtempers are uſually conſequent. There are, indeed, various medicines, ſuch as aromatics and ſpirituous liquors, diſtilled from fermented vegetables, ſometimes ſucceſsfully employed to correct this dull diſpoſition of the blood; but as theſe prove very hot, there will be ſeveral conſtitutions, and particular circumſtances wherein they may do more harm by their immoderate heat, than good by their ſpirituoſity. Beſides, the ſluggiſhneſs of the blood may ſometimes proceed from cauſes, that this ſort of hot medicines will not correct. I remember, that having moderately dry'd and powder'd a parcel of human blood, a vinous ſpirit totally inflammable, would not in many hours make a ſolution of it, or draw a red tincture from it; but a well rectified urinous ſpirit grew red upon it, in leſs than the tenth, or perhaps the twentieth part of that time.

A ſpecific

MEDICINE. A ſpecific medicine may, therefore, abound in corpuſcles of ſuch a nature, as, without dangerouſly heating of the blood, to diſſolve thoſe particles that render it viſcid, ropy, or ſpiritleſs; and alſo, by elivening the whole maſs, and putting it into a more briſk and kindly agitation, thereby fit it to throw off ſuch heterogeneous parts, or recrements, as were blended with it before; whence 'twill again freely paſs along the finer veſſels of the body.

That a ſpecific may perform this, will be more eaſily allowed, after conſidering that the generality of phyſicians acknowledge, there are ſeveral cordials, ſome of which they ſtile temperate, and others cold: and 'tis very poſſible, that the corpuſcles, which render the blood thick and ſluggiſh, may not be of a cold nature, but of a hot; and therefore may have their effects rather promoted than deſtroyed by hot remedies. Thus, as we formerly ſaid, if to the white of an egg you put a certain proportion of well rectified ſpirit of wine; inſtead of deſtroying the viſcoſity of the liquor, it will curdle a good part of it, and thereby produce a body far more remote from thinneſs and fluidity than it was before. And I remember I once made a ſluggiſh vegetable liquor, which preſently, by the addition of a little ſpirit of wine, became ſurprizingly viſcous and ropy.

2. Another means, whereby a ſpecific may befriend the maſs of blood is, by giving it the wanted dilatation or tenuity. This ſecond way, indeed, is of kin to the firſt, but different from it; becauſe in that the thing principally conſidered was, the fermentation or agitation of the blood; but this chiefly reſpects the conſiſtence of it; a particular of great importance to health: for if the blood be too thick, as often happens, it cannot paſs ſo freely and readily as it ought, thro' the capillary veſſels; which thence become gradually obſtructed, and the circulation retarded. And, on the other ſide, if the blood be too thin, and eſpecially if too vehemently agitated, 'tis apt to make its way out of the veſſels, and produce hemorrhages, or other bad effects, that uſually attend the extravaſation of the blood; which happening in ſo warm a place as a living human body, that fluid is very apt to putrefy, and thereby produce impoſtumes, and ſeveral dangerous ſymptoms.

Now a ſpecific medicine may remedy this faulty conſiſtence of the blood, by furniſhing it with corpuſcles, fitted by their figure, bulk, motion, &c. to diſable thoſe that make the blood groſs; or elſe to cut or divide the parts of the blood it ſelf, and ſo diſpoſe them to a greater fluidity. It may alſo produce in it ſuch pores, as will give admiſſion to the ſubtile etherial matter, that abounds in the atmoſphere, whereby the blood may be rarified. And, on the other hand, when the blood is too thin, as not only ſome diſeaſes, but ſome medicines too, eſpecially aloes, often make it; a ſpecific may reduce it to a good conſiſtence, either by furniſhing it with corpuſcles, apt to combine with the active ones, that did too much attenuate it before; or by helping

nature

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MEDICINE. tations and contractions, as flow from the agreeable paſſions. And, what favours this conjecture, a lady of my acquaintance has complained to me, that the ſcent of perfumed gloves makes the blood fly to her face, and long continue to tinge it, in the nature of a bluſh.

In this manner, then, a ſpecific, by peculiarly affecting the heart, may greatly contribute to introduce, or re-eſtabliſh, a healthy craſis in the blood; which, being thus rectified and invigorated, may both befriend the body in general, and conduce to remove ſome particular diſeaſes, by ſtrengthening, and, perhaps too, exciting the particular part, in which the peccant matter reſides, to ſubdue or expel as much of it as it already harbours, and to reſiſt the acceſſion of more. And the blood being thus brought to a good ſtate, and the ſolid parts corroborated, the ſpecific that produces theſe effects, may be ſaid to cure ſome particular diſeaſes, which only continue by being frequently ſupply'd with vitious matter from the blood in its circulation.

PROP. VI.

A ſpecific remedy may unite its particles with thoſe of the peccant matter, and thereby conſtitute ſome different ſubſtance, to be eaſily thrown off, or ſafely continued in the body.

This I take to be one of the moſt proper and genuine methods of operation in ſpecific medicines; becauſe an effect is here produced, either without the aſſiſtance, or beyond the mere power of the manifeſt qualities of the remedy, and a cure, or relief uſually obtain'd without violence, torture, or diſorder.

This manner of working in a ſpecific medicine, is of near affinity with one or two of thoſe formerly mention'd; but different from them in ſome particulars, as will appear hereafter. Sometimes, when a certain kind of acid has impregnated the blood, or lodg'd it ſelf in ſome ſolid part of the body, the corpuſcles of a ſpecific may, without any ſenſible conflict, be ſo qualified, as to make coalitions with the particles of the peccant acid; and, with them, conſtitute little concretions, which, differing from the minute parts of the acid, either in bulk, figure, ſolidity, ſtiffneſs, motion, or in two or more of theſe may become quite of another nature, and much more innocent than the acid it ſelf, before it was thus corrected. We are furniſhed with a notable illuſtration hereof, by digeſting *Aqua fortis* with an equal, or double weight of inflammable ſpirit; for, by this means, I found, that highly acid liquor ſo chang'd, as not to retain any ſenſible coroſiveneſs; and to exchange its piercing ſcent, and great acidity, for an inoffenſive, pleaſant ſmell, and a grateful, and actually ſweetiſh taſt. Which brings into my mind the practice of a preſident of the famous college at *London*, who, as himſelf told me, uſed to relieve a patient of very great quality, of nephritic torments, by giving her a large

doſe

doſe of an inflammable ſpirit. But ſpirit of wine, by its effects upon ſeveral other acid menſtrua, wherewith I mix'd and digeſted it, appears not to work upon them uniformly, as they are all of them acids, but differently, according to the nature and proportion of the acid corpuſcles, with which the vinous ſpirits aſſociate. MEDICINE.

And to ſhew, that this change and contemperation of the menſtruum, by the ſpirit of wine, is produc'd rather by a peculiar fitneſs of the convening corpuſcles of both, than by the contrariety that the vinous ſpirit has to the *Aqua fortis*, as an acid; I ſhall add, that pure ſpirit of wine, mix'd in a due proportion with highly rectified ſpirit of urine; will greatly abate its cauſtic property; and with it compoſe a ſalt much more moderate than the ſpirit; and which, being ſublimed, or rather reduced into a liquor, affords an excellent mixture, in ſome fevers and other diſeaſes as a medicine: and, with a ſmall ſkilful alteration, it is of great uſe in many chymical experiments as a menſtruum.

A few grains of the glaſs of antimony, made without addition, being taken inwardly, will vehemently both vomit and purge; and tho' wine if well impregnated with its corpuſcles, proves a violent emetic and cathartic; yet if ſpirit of vinegar, that is, of degenerated wine, be, for a competent time, digeſted upon the glaſs finely powder'd, and when the liquor is ſufficiently impregnated with the particles thereof, abſtracted from it, there will thence ariſe a multitude of minute concretions, of which many grains may be given, without ordinarily provoking either vomit or ſtool. All mortifications, therefore, uſefully made by medicines, need not be of acids; ſince we here ſee, that acids themſelves may prove correctors: and, perhaps, it is by ſuch kind of combination, that ſome poiſons are ſubdued. I ſuſpect that it may as probably be upon this account, as upon any hitherto offered, that a man, ſtung with a ſcorpion, is cured by cruſhing the animal upon the hurt; as an acquaintance of mine told me he try'd upon himſelf; and a virtuoſo upon a ſoldier, with good ſucceſs. And, conſidering what a multitude and variety of figures, may fit ſuch particular corpuſcles to make coalitions, very different from both the component parts, it ſeems probable, that in a patient's body there may be made between the corpuſcles of the peccant matter, and thoſe of a medicine, ſuch uſeful combinations, as to produce concretions innocent or beneficial.

When a particle of peccant matter comes to be aſſociated with one of a ſpecific medicine, that combination may alter it for the better, not only by changing its magnitude and figure, but alſo by encreaſing or leſſening its ſtiffneſs and ſolidity, and giving a new modification to its motion; as will eaſily appear from a little attention to the natural conſequences of the coalitions of bodies.

I might ſhew, *ex abundanti*, that the ſmall concretions made by the union of ſome morbific, with ſome medicinal corpuſcles, may not only become innocent, but ſometimes beneficial, by what happens to common

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ſublimate, from a farther preparation; for tho' this be a ſubſtance ſo highly corroſive and miſchievous, that a few grains of it will kill a man; yet by making a coaleſcence, with leſs than its weight of quick-ſilver, which is a body inſipid and ſcentleſs, the corroſive matter is thereby ſo alter'd and tamed, as to be turned into a kind of white, taſtleſs earth, call'd *Mercurius dulcis*; which, if ſkilfully prepared, and given in the quantity of many grains, is not only innocent, but a very good medicine; and that, perhaps, in more caſes than phyſicians are generally aware of.

And this may afford us a probable argument, to ſhew, that, notwithſtanding all the digeſtions and changes a ſpecific medicine undergoes in its paſſage thro' the body, it may ſtill prove ſalutary, when it arrives at the part it ſhould relieve. For, tho' the corpuſcles of the medicine ſhould be conſiderably chang'd by the way, yet 'tis poſſible they may, by that very alteration, be made medicinal; ſince they may thus be qualified, when they arrive at the part affected, to combine themſelves ſtrictly with ſome corpuſcles, whether morbific or others, that they find there; and with them compoſe new concretions, of a nature very friendly to the patient. Something analogous to this we may obſerve in aſparagus, which being eaten, affords ſtore of particles, that, mixing with thoſe they meet with in the kidneys, or the bladder, produce a new odour, very different both from that of mere urine, and from that of the plant. Thus, alſo, if good turpentine be taken by the mouth, 'tis known, that, arriving at the kidneys and bladder, it will mix its minute parts with thoſe it meets with there; whence emerge corpuſcles, that give the urine a very different ſcent, from that of either of the liquors; for it often has a fragrancy like violets.

Before I conclude this ſubject, it ſeems proper to take notice of a difficulty, that may, in general, be objected, to what has been hitherto deliver'd. It might be ſaid, that my arguments and explanations all along ſuppoſe the ſpecifics to be taken at the mouth; while 'tis known, that many external remedies are reckon'd among ſpecifics, which, perhaps, do but barely touch the body, as is the caſe in amulets, rings, *&c.* But we may take notice, that the confidence with which many phyſicians reject, and ſome of them deride external ſpecifics, ſeems built upon this, that the medicine cannot get into the body; or, that in caſe it ſhould have ſome part of it ſubtile enough to gain admittance, that part muſt be too ſmall and inconſiderable, to produce any ſuch great change, as is neceſſary to the expulſion of peccant humours, and the conquering of a diſeaſe.

In anſwer to the former of theſe ſuſpicions; 'tis certain, that the human ſkin, tho' it ſeems an entire continued body, is really perſonated with a great multitude, and, perhaps, variety of little outlets, which we call pores; many whereof are viſible by good microſcopes, even in the ſkin of dead animals; and others are manifeſtly inferr'd from the numerous little drops that cover the whole ſurface of it, at the

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as to act on ſolid bodies contained therein, I have experimentally ſeen, and made appear to others.

Secondly, that the corpuſcles of a medicine may retain their nature and power of operation, notwithſtanding their being ſtrained thro' the ſkin. For mercury is often found in the form of quick-ſilver, in the dead bodies of ſome men, who had been frequently anointed with mercurial unguents. And, by this means, a patient may be as violently ſalivated, as if he had ſwallowed mercurial medicines. Thus I have frequently obſerved, that a little opium, mixed up with other ingredients for a plaiſter, would, by outward application, take off the acute pains of remoter internal parts.

And, laſtly, that the corpuſcles of a ſpecific may, on ſeveral occaſions, act more powerfully, by getting in at the pores of the ſkin, than if the remedy had been taken at the mouth; becauſe its particles might, in the latter way, be divided, or greatly alter'd, by the ferment of the ſtomach, by their filtration in the inteſtines, and their long and winding paſſage thro' them and the lymphaducts, before they arrive at the heart, to be mingled with the blood; whilſt the corpuſcles of an external ſpecific, preſently after they are paſt the ſkin, get into the contiguous capillaries, and thence preſently paſs into the fluids, unalter'd. Whence it appears, that thoſe phyſicians are much miſtaken, who think a topical medicine can, at beſt, only relieve the part it is apply'd to.

And, what is more extraordinary, bodies outwardly apply'd, may prove ſpecifics for ſome diſeaſes, for which, by the bare knowledge of their effects, when taken in at the mouth, they might ſeem not ſuited. Thus camphire ſwallowed, is, in the doſe of a very few grains, a great heater of the blood; and, in ſome countries, extoll'd by phyſicians in particular kinds of ill-conditioned fevers; yet it is outwardly apply'd to take off thoſe redneſſes of the face, that are thought to proceed from a heat of blood, and uſed in ointments againſt burns. Thus, ſpirit of wine, which tho' ſo hot when drunk, is a very good remedy in burns; eſpecially if the part be early moiſtned therewith. Bread, that is counted ſo moderate and well-temper'd an aliment when eaten, has, if chew'd and outwardly apply'd, conſiderable virtues in ſeveral external diſorders. And I know an ancient and experienced phyſician, who uſes to purge ſuch children as will not eaſily be brought to ſwallow medicines, by applying ſomething to their navels, that does not offend them by its colour, ſmell, or griping. And this himſelf, more than once, confeſs'd to me, is but an ordinary aliment, which moſt men, and I among others, have frequently taken, unprepar'd.

'Twere eaſy to mention a great many external ſpecifics, from the writings of phyſicians; but I purpoſely forbear it, becauſe, to ſpeak freely, I ſuſpect that moſt of thoſe remedies, tho' greatly extoll'd, have been but little examined by the perſons who deliver them. And

it may ſuffice for my preſent purpoſe, to alledge a few inſtances, that have been recommended to me either by my own experience, or that of ſome friends. MEDICINE.

I lived in the ſame houſe with a learned and judicious perſon, who being ſubject to paralytic fits, and to be frequently tortur'd by violent cramps, was uſually, on a ſudden, relieved, by wearing, or handling, the tooth of a true hippopotamus, or river-horſe. And he affirmed to me, that upon leaving off the uſe of it for any conſiderable time, either out of curioſity, or to ſatisfy ſome friend, the fits would return, with violence, upon him. I remember alſo, that having my ſelf been, for ſome years, frequently ſubject to cramps, and complaining of it to a phyſician who had travelled into cold countries; he told me, that he had brought home with him ſome rings, made of the true elk's hoof, from a place where thoſe animals are uſually employ'd; and that with theſe he had cured many of the cramp: one of them he preſented me to make trial with; which I the more willingly accepted, becauſe he aſſured me, that ſeveral of them, ſold for genuine, were either counterfeit, or of no efficacy. And, tho' I did not find, that if the cramp ſeized me in the calf of the leg, the ring would much relieve me; yet when the fits were but moderate, and in other parts, eſpecially the hands, I found my ſelf eas'd ſo often, and ſo ſuddenly, that I was at firſt ſurprized at it; and uſed to have the remedy laid, every night, by my bed-ſide, to be ready upon occaſion. And what ſeemed ſtrange, I ſeveral times found, when the cramp ſeized my foot, or my toes, the pain was quickly removed, tho' I only apply'd the ring to my finger.

An eminent phyſician, diſcourſing with me concerning a patient of his, that was ſubject to a nocturnal *Incontinentia urinæ*; I told him of an empyrical remedy, and which, at leaſt, ſeemed ſafe, tho' it ſhould not prove effectual; and it was only a ſimple animal ſubſtance, to be worn in a ſarſenet bag, next the ſkin; for which the phyſician long afterwards gave me thanks, and told me, he was ſurprized at the effect thereof; but that he obſerved, when the patient had worn it, till probably the virtue began to decay, that is, till its effluvia were almoſt ſpent, he found occaſion for a freſh remedy.

I do not affirm that theſe appenſa, any more than other remedies, will always ſucceed; and I think one may affirm ſome probable reaſons for the want of uniformity in their effects. But for my preſent argument it ſuffices, that they ſometimes ſucceed; ſince that is enough to ſhew it poſſible, that outward medicines may operate upon inward diſtempers.

A young lady was cured of a large tumour in her neck, ſuppos'd to be ſcrophulous, by barely applying to it the hand of a man, who died of a lingering diſeaſe, till ſhe felt the coldneſs thereof penetrate to the innermoſt parts of the ſwelling; the operation being repeated more than once whilſt the corps continued ſweet. This method was adviſed by

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one of the moſt candid and ſkilful phyſicians of the *London* college, who gave me this relation, and ſhewed me a very noble preſent, which he received for his advice. This remedy is mentioned by *Helmont*, and long before him, by *Pliny*; tho' its virtue generally ſeem'd to have been diſbelieved, or forgotten, till *Franciſcus Ulmus* took notice of a caſe very like the preſent; affirming, that by this remedy alone, after others had been fruitleſly employed, he knew a noble virgin to have been perfectly cured.

I was, one ſummer, obnoxious to frequent bleedings at the noſe, for which I ſometimes uſed one remedy, and ſometimes another; and, for the moſt part, with good, tho' not with ſudden ſucceſs. But falling once into a fit, the violence whereof alarm'd me, I reſolved to try an unuſual remedy, the true moſs of a dead man's ſkull; which had been ſent as a preſent out of *Ireland*, where it is more eſteemed than elſewhere: this remedy I did not employ in the uſual manner, by putting it up my noſtrils; but, notwithſtanding the briſkneſs of my hemorrhage, try'd, whether the medicine would produce its effect by being only held in my hand; by which means I found, to the ſurprize of the by-ſtanders, that the blood ſpeedily ſtopp'd: nor have I been troubled with it ſince that time. But this is far leſs ſtrange, than what was affirmed to have happened to one of the moſt eminent members of the royal ſociety; who, being of a very ſanguine complexion, found himſelf ſo violently affected by the moſs of a human ſkull, that ſometimes, when he was let blood, if, for curioſity ſake, he held a quantity of this moſs in his hand, the blood would ceaſe running till he laid it aſide. This was not only ſolemnly averr'd to me by himſelf, but confirmed by his ingenious phyſician, with both whom I had a particular acquaintance; otherwiſe I ſhould have thought the thing ſcarce credible, unleſs imagination, a faculty very ſtrong in that gentleman, contributed to the ſtrange effect of the remedy.

The external ſpecifics hitherto mentioned, are afforded by vegetables and animals; which, being bodies of a ſlight texture, may be ſuppoſed to have their parts more volatile; I ſhall, therefore, produce two or three examples from the mineral kingdom; the ſubjects whereof are generally thought indiſpoſed to emit effluvia.

I knew a phyſician, who enjoyed a good ſtate of health, except that after a few hours ſleep, he waked in the night with great terrors, followed, for a long time, by violent and frightful palpitations of the heart. To remove this diſorder, he try'd all that his art ſuggeſted, but without ſucceſs: happening afterwards to mention his caſe in a company of merchants; one of them told him, he might eaſily find relief, from a remedy that had been found efficacious, both upon himſelf and others. This he ſaid was to take flat and ſmooth cornelian ſtones, ſuch as they bring for rings from the *Eaſt-Indies*, and to ſew eight or ten of them to a piece of ſcarlet cloth, or flanel, to be hung about his neck; ſo that they immediately touch the ſkin over-againſt the

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

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Thus then, from a bare conſideration of the ſubject, have I ſhewn ſome of the principal ways, by which, I conceive, ſpecific medicines may cure diſeaſes, or, at leaſt, much leſſen them. But I am far from denying, that there may be many others, whereby the ſame effects may be produced.

And, as I did not pretend, that a ſpecific medicine, or nature, by means thereof, commonly effects a cure by any one of the particular ways propos'd, excluſive of the reſt; but rather think, that two or more of them may ſometimes concur to the effect; ſo neither did I propoſe to explain their particular ways of working; but only to ſhew them in general. Nor do I, laſtly, aſſert, that the means I have pitch'd upon are the true and genuine ones, by which the medicine acts, but propoſe a poſſible one, by which it may act; ſo that I only offer my explanations, as poſſible, or not improbable; which is ſufficient to anſwer my deſign in proving the notion of ſpecific remedies, agreeable to mechanical philoſophy.

SECT. II.

The uſe of ſimple medicines recommended.

SINCE ſpecific medicines muſt, to deſerve that name, be very efficacious, yet are, for the moſt part, either ſimple, or very little compounded; what we have deliver'd concerning them, affords me a proper occaſion to invite the faculty of phyſick, to the uſe of ſuch remedies, as are either ſimple; or when compoſitions are neceſſary, to employ no more ingredients than are abſolutely neceſſary to anſwer the indications.

This ſort of ſimple, or lightly compounded remedies, I am induced to prefer to thoſe crowded compoſitions, wherein men ſeem to have aimed at conquering diſeaſes by the multitude of their ingredients; and this for ſeveral reaſons. But, before I produce them, I deſire the advantages, here aſcrib'd to ſimple medicines over others, may be underſtood not in an abſolute, and indefinite ſenſe, but *Cæteris paribus*.

From the advantage of foreſeeing their effects.

Firſt, then, it is much eaſier to foreſee the operation of a ſimple, than of a very compound medicine; ſo that phyſicians may proceed more ſecurely in employing the former than the latter. And, indeed, if I do not greatly miſtake, we often preſume too much upon our own abilities, in ſuppoſing we know before-hand what will be the qualities and effects of a mixture of many ingredients of different natures; ſince ſeveral bodies, by compoſition, and the change of texture conſequent thereon, receive great and unexpected alterations. Several manifeſt inſtances of this truth, may be met with in colours, where what is produced by the mixture of bodies, appears quite different from that of any of the ingredients employ'd. As when a blue

ſolu-

ſolution of copper, made in ſpirit of urine, produces with ſyrup of violets, which is alſo blue, a fair green. MEDICINE.

Thus, alſo, having put together ſome tincture of iron, made with good ſpirit of vinegar, and a volatile tincture of ſulphur; from a confuſion of theſe, two very red liquors, there immediately aroſe a very dark, and almoſt inky mixture, that retained no redneſs at all.

The like remarkable changes I have ſeveral times produced, by mixtures, in ſeveral other qualities of bodies, beſides their colour, as in their odours, taſts, *&c.* And why ſuch alterations may not be alſo effected by compoſition in ſome medicinal qualities of bodies, I cannot ſee. Quick-ſilver, inwardly taken, uſually cauſes either no evacuation, or one at the mouth; but if diſſolved in ſpirit of nitre, and precipitated with ſea-ſalt, it yields a white precipitate; which being edulcorated, and warily given in a juſt doſe, ſeldom fails to work, not by ſalivation, but by ſtool. On the other hand, glaſs of antimony, whereof a very few grains, given in ſubſtance, prove violently cathartic and emetic; yet, being diſſolved in ſpirit of vinegar, will not uſually either vomit or purge; tho' the menſtruum be drawn from it, and the glaſs given in a larger doſe than when pure and unmixed.

And tho' by fluxing crude antimony with nitre and tartar, as in the ordinary way of making *Crocus metallorum*, there is produced a medicine ſo very emetic and cathartic, that an ounce, or leſs of the wine, wherein it has been infuſed, tho' without ſenſibly loſing its weight, will operate ſtrongly, both upwards and downwards. Yet I have known ſome perſons, who would, without ſcruple, take ſeveral grains of crude antimony, in ſubſtance; and one particularly, who long continued the uſe of it, without being vomited, or purged thereby. And trials, purpoſely made, have informed me, that if, inſtead of ſalt-petre and tartar, antimony be prepared with well dry'd ſea-ſalt, and a little ſalt of tartar, tho' both theſe amount not to above half the weight of the nitre and tartar vulgarly uſed; yet the antimony well fluxed with theſe for about an hour, is thereby ſo altered and corrected, as to afford an uſeful medicine; of which may be given from twelve grains to half a dram, or more, in ſubſtance, without ordinarily working either by vomit or ſtool, but uſually by ſweat, and ſometimes by urine. Whence we ſee, that antimony may be either made a more dangerous or a more friendly medicine, than it is of it ſelf, according to the ingredients wherewith 'tis aſſociated; tho' theſe be in themſelves innocent, and, perhaps, of kin to one another. And even chymiſts, as well as other preſcribers of remedies, ſometimes add to a ſimple, ſuch things as rather deprave, than improve it. Thus one of their great patrons complains, that flower of ſulphur, by being ſublimed from calcined vitriol, *&c.* under pretence of purifying and ſubtilizing it, really acquires a hurtful corroſiveneſs.

2. Another advantage of ſimple medicines is, that, *cæteris paribus*, they are more ſafe than compounds, eſpecially if the patient be valetudinary. *Their being more ſafe.*

MEDICINE. tudinary. 'Tis too frequent, both in herbariſts and other writers on the *Materia medica*, to give us rather encomiums, than impartial accounts, of the ſimples they treat of. Thus they enumerate and magnify all the virtues they have, and ſometimes more than they have; without taking notice of their ill qualities; upon whoſe account, nevertheleſs, they may be inconvenient, hurtful, and dangerous to ſome conſtitutions: as, in particular caſes, ſeveral perfumes, tho' very grateful and refreſhing to moſt men, are yet very hurtful to many women, and eſpecially to the hyſterical. I have known the ſmell of muſk greatly diſorder an eminent perſon, tho' otherwiſe of a robuſt conſtitution. I have alſo known ſeveral perſons of both ſexes, very much offended by the ſcent of roſes. Wormwood, tho' for many purpoſes an excellent plant, has been ſo often found to diſaffect the head and eyes, that I have, for ſome years, forbore it my ſelf, for fear of the head-ach, and forewarn'd others of it whoſe eyes are weak. I am acquainted with a very learned phyſician, who, tho' he has naturally very good eyes, found, upon an obſtinate trial, that the plentiful uſe of wormwood, in wine and beer, ſo greatly decayed his ſight by degrees, that at length he could not read a gazette without ſpectacles; but by barely leaving off the uſe of that plant, he quickly recover'd the vigour of his eyes. This relation I had from himſelf, ſoon after the thing happened.

And I queſtion not that we might find, upon ſtrict enquiry into the nature of ſimples and medicines, many that have bad qualities, unobſerved by phyſical authors. I have more than once foretold ſome hurt that patients would receive, by the uſe of applauded medicines, preſcribed them by conſiderable men; when, upon their authority, my warnings were neglected, and the uſe of the remedies unhappily perſiſted in. I once ſaw in the hands of a learned traveller, an *Arabic* manuſcript, about the *Materia medica*, the method whereof ſeemed more accurate than any thing I had met with on that ſubject. For the author had been ſo wary, that, after the columns wherein he taught the virtues, doſes, *&c.* of every drug, he had a diſtinct one for its bad qualities, with the conſtitutions and diſeaſes, wherein the uſe of it might be dangerous or inconvenient. I think it, therefore, reaſonable to ſuſpect, that, where a great many ingredients are blended into a ſingle medicine, one or other of them may have different operations from thoſe deſigned by the phyſician; and, by awakening ſome ſleeping ferment, produce a new diſtemper, or excite and actuate ſome other hoſtile matter, that lay quiet before, and which would have been gradually ſubdued by nature, had it not been unſeaſonably rouzed, and aſſiſted by ſome ingredients, that, perhaps, was, without any reaſon, added to the medicine. I have had ſo many unwelcome proofs of this in my ſelf, that it engages me the more, to caution others againſt the like inconvenience.

3. Another

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MEDICINE. in a ſufficient quantity, and for a competent time. There are alſo many inſtances of dangerous and ſtubborn diſeaſes, that have been cured by common cows milk, when drunk very plentifully, and for a long time together. Perhaps, it is no leſs remarkable, that in a few days time, diarrheas and dyſenteries are happily and eaſily cured, as I have ſometimes known them, by the bare uſe of ſo ſlight a remedy as milk, wherein, whilſt it is gently boiling, an equal quantity of fair water is added, little by little, till at laſt there remains but as much liquor, as the milk alone amounted to at firſt. This ſimple alimental medicine, being freely uſed for common drink, has been very frequently found to cure different kinds of fluxes, even in *Ireland*, where they are endemical. I have formerly recommended *Paronychia foliis rutaceis*, againſt that ſtubborn diſeaſe, the king's-evil; but muſt not here omit a notable confirmation of the utility of an alterative ſimple, given in a conſiderable quantity. A phyſician whom I knew, was ſent for to a ſcrophulous patient, in whoſe throat he found a tumour ſo large, and ſo unluckily ſeated, that greatly compreſſing the œſophagus, it render'd deglutition exceeding difficult; the tumour was likewiſe ſo hard and ſtubborn, as not to be diſcuſs'd, nor brought to ſuppuration; whence the patient was put in imminent danger of being ſtarv'd. In this ſtrait, the phyſician remembring the character I had given of whitlow-graſs, ſent about the country to get all that could be procured; and at firſt gave a little of it, in the form of infuſion, in ſuch liquid aliments as the patient was able, tho' with great difficulty, to get down: and having, by this means, after ſome time, gradually made the deglutition more eaſy, he gave the remedy in greater plenty, to imbue the whole maſs of blood, and juices of the body, with the virtue of the herb; whereby the tumour was at length diſſolved, and the patient ſecured.

And tho' I might here enumerate the virtues of ſome other ſimple remedies, plentifully given, I ſhall rather obſerve, in general, that ſeveral alterative ſimples would, doubtleſs, be found far more effectual than is commonly thought, if they were given in a very large doſe, and continued for a competent time. And, probably, many phyſicians would not be ſo forward, as they are, to reject either ſpecific or ſimple remedies, if they allow'd them as fair a trial as their own preſcriptions; ſuch as the officinal chalybeates, the *Spaw* or *Tunbridge* waters, the decoctions of guaiacum, *&c.* which they often give, with many intermediate helps, for a month or ſix weeks, or ſometimes two months together, without expecting they ſhould perform the cure in a few days.

Eaſily procurable. 4. The fourth conſideration, that recommends the uſe of ſimple medicines, is, that, *cæteris paribus*, they are more eaſily procured than compounds. This aſſertion needs little proof. And, where ſeveral ſimples are required, one or more of them may often prove difficult to be got; and all of them will ſtill be troubleſome to form into a com-

compoſition. How uſeful the knowledge of parable remedies is, I need not here endeavour to prove; but ſhall add, that ſome medicines are eaſily obtained, without reſorting to the ſhops of apothecaries; ſince thoſe of artificers are often furniſh'd with them. Thus among maſons, and bricklayers, we commonly meet with quick-lime, whoſe bare infuſion, in common water is, of it ſelf, an excellent medicine in ſeveral caſes; and, as experience has taught me, may be made the baſis of ſeveral good remedies, both external and internal: among the latter of which, may be reckon'd an ointment, that I uſually keep by me, againſt burns; made only by beating up ſtrong lime-water, with as much good linſeed oil, as can be made throughly to incorporate with it into a white unguent.

The linſeed oil, which is to be had in the ſhops of varniſhers and painters, exhibited, alone, in a large doſe, as that of ſeveral ounces at a time, I have known prove very ſerviceable in breaking pleuritical empyema's. Simple oil of turpentine alſo, that may be uſually had in the ſame ſhops, is a noble remedy in many diſeaſes. And I have receiv'd great thanks, both from phyſicians and chirurgeons, for recommending the uſe of it to them in wounds; and, particularly, where one would expect little from it, in the ſtanching of blood, if it be ſeaſonably apply'd very hot to the wounded parts; whilſt it alſo greatly promotes a good digeſtion. A chirurgeon to a great monarch, and one of the moſt ſkilful men I ever met with of his profeſſion, confeſs'd to me, that in an admir'd cure, which he perform'd of a deſperate gangrene, in an eminent perſon, very aged, and almoſt bed-rid, the medicine he aſcrib'd moſt to, was the oil we were ſpeaking of. And becauſe he, and others, frequently uſe ſpirit of wine with good ſucceſs, in gangrenes, which being ſuppos'd incapably of mixing with oil of turpentine, I thought it might prove of ſervice to practitioners, to be able to make a mixture of the two, that might, probably, be more penetrant than the one, and leſs fugitive than the other. Such a mixture I eaſily made, by digeſting, for a while, and ſtrongly ſhaking, from time to time, about equal parts of good oil of turpentine, and throughly dephlegm'd ſpirit of wine, till by imbibing, or diſſolving, great ſtore of the oleaginous parts, the liquor obtain'd a yellow colour: for which reaſon I call it the tincture of oil of turpentine.

There is another ſimple, to be found in the ſhops of colour-ſellers, which, tho' very offenſive to the taſt, and ſomewhat diſagreeable to the ſtomach, hath a very great anti-nephritic virture. I procured it with difficulty, from a very extraordinary chymiſt, who, tho' a ſparing commender of remedies, extoll'd this, as the beſt he ever met with to cure the ſtone, where it was not too big to paſs, and to prevent the increaſe of it where it was. I have alſo known it us'd glyſter-wiſe, with very good ſucceſs, in a fit of that diſeaſe; but inwardly, I had no occaſion to try it, except upon my ſelf: and judging it innocent, as indeed I found it rather anodyne than forcing, I took it now and then,

MEDICINE. then, mix'd with oil of ſweet almonds, to allay the taſt, as a preſervative from the gravel; for which purpoſe, I thought it more manifeſtly effectual, by leſſening either the bulk of the grains, or the quantity of the ſand, or both, than any of the remedies I had uſed, with the ſame view, for ſeveral years before; yet I ſcarce took a quarter of the doſe, preſcrib'd by the perſon who communicated the medicine to me. His order was, to take, from time to time, either by it ſelf, or in ſome convenient vehicle, two or three ounces of the ſtale expreſs'd oil of walnuts.

Before I leave the ſhops of tradeſmen, I ſhall take notice of one medicine more, that ſeems to have been firſt lodg'd there, and from thence tranſlated into the ſhops of apothecaries. The medicine, I mean, is *Caſtile* or *Venetian* ſoap; which being a body, abounding with alkaline ſalts, and oleaginous parts well combined, invited me to make ſome experiments with it, as a ſubſtance applicable to phyſical uſes. As to its medicinal virtues, 'tis prevalent againſt the jaundice; for which purpoſe, as I have been inform'd, 'tis in great requeſt among ſome ſkilful men in *Holland*; and experience has recommended it to me againſt the ſtone: but that for which I chiefly prize it, is its virtue in caſe of making bloody urine. A conſiderable merchant of *Cork*, in *Ireland*, being afflicted with this diſtemper, in ſo violent a degree, as to be thereby unqualified for his buſineſs; I adviſed him to ſcrape as much *Caſtile* ſoap into a ſpoon, as it would conveniently hold, without being preſs'd, that is, near a dram in weight; and having fill'd the vacant part, with ſome convenient vehicle, to ſwallow it, and waſh it down with a large draught of the ſame liquor; repeating the doſe twice or thrice a day, if need required. The manifeſt relief he found, by this ſeemingly deſpicable medicine, within two or three days, invited him to continue the uſe of it a while longer; by which means he has now, for ſome years together, liv'd quite free from his diſtemper, without ſcrupling to ride on horſeback as his occaſions require. This gentleman farther told me, he had adviſed the ſame remedy to ſeveral others in the like caſe, who were, likewiſe, happily cured by the uſe of it.

And likely to improve the knowledge of the Materia Medica.

5. The laſt, and principal reaſon, that induces me to wiſh phyſicians would employ ſimple remedies, as much as poſſible, is its being one of the likelieſt ways, and, perhaps, abſolutely neceſſary to promote the practical knowledge of the *Materia medica*; for, whilſt a multitude of ingredients are crowded, or confounded, in one receipt, 'tis almoſt impoſſible to know, with any certainty, to which of the ſimples the good or bad effect of the remedy is to be aſcrib'd; or whether it be not produc'd by a power, reſulting from the particular qualities of them all, united under one temperament, and acting, conjointly, as a whole. So that by this method, of jumbling ſimples into compounds, I ſee not how, in many ages, men will be able to diſcover the true qualities of the particular bodies, compriz'd in the *Materia medica*.

On

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE. " to uſe a compound medicine properly, without being perfectly ac-
" quainted with the virtue of the ſimples that compoſe it."

I preſume it will be eaſily allowed, that much of what has been ſaid in favour of ſimple medicines, may be extended to many of the remedies afforded us by chymiſtry. For, without now entering into the queſtion, whether the ſpirits, oils, and ſalts, obtained by the fire, are principles in the ſtrict ſenſe of the word; it will ſcarce be doubted, that the ſpirit, the oil, or the ſalt of a mixed body, chymically reſolved, is ſo ſlightly, or unequally compoſed, that the ingredient whence it takes its name, is far more predominant there, than when combined with others in the entire or uncompounded concrete. And, that ſuch ſuppoſed principles, or medicines, of a ſimple order, will prove very efficacious, may be juſtly argued from the great and beneficial effects of oil of vitriol, ſpirit of urine (a medicine of great uſe both externally and internally) ſpirit of hartſhorn, ſpirit of nitre, ſpirit of wine, and oil of turpentine: of which laſt I ſhall add, that, beſides the virtues already aſcribed to it, whilſt it retains its ſimplicity, it may, in many caſes, be employed as a menſtruum; and, by being combined with an ingredient or two, be made to afford various medicines; which, tho' but little compounded, are of great virtue. For, I have found it readily diſſolve camphire, maſtic, and ſome other gums, of which balſams may be made; and others may, by the help of the ſame liquor, be obtained, even from ſeveral mineral and metalline bodies. I will not inſiſt on ſo known a medicine as the common terebinthinate balſam of ſulphur, tho' this be a remedy, which, as much as 'tis peculiarly extoll'd for diſeaſes of the lungs, has virtues unconfined to the diſtempers of that part; ſince both I, and ſome I recommended it to, have found it very effectual, outwardly apply'd, in troubleſome hemorrhoidal pains and tumours: and experience inclines me to think its virtues may not be much greater in pulmonic, than in paralytic diſtempers; in the latter of which it may be uſed not only outwardly, but, to more advantage, inwardly, and that in a pretty large doſe, with a cephalic, and, in ſome caſes, an anti-ſcorbutic vehicle. But I ſhall rather take notice, that, perhaps, it will be found worth while to try, at leaſt in external diſorders, the uſe of ſeveral tinctures, and conſequently balſams, that may be obtained by the help of oil of turpentine, from ſome ſolid mineral bodies; by which I have found, upon trial, this liquor may be tinged; and among them, I ſhall name, beſides crude zink, crude antimony, and even crude copper, a noble ſubject, antimonial cinnabar; from whence, tho' I could draw a fine tincture, I had not opportunity to make trial of ſo promiſing a medicine.

That chymical remedies, alſo, ſhould be ſimple.

6. And as for ſuch other medicines as are not made by bare analyſis, but by ſyntheſis, or compoſition; tho' I think an experienced chymiſt may, in many caſes, with leſs uncertainty than a *Galeniſt*, foreſee what quantity the mixed body this way produced, may have; yet

yet I could wiſh, that chymiſts were more ſparing in the number of the ingredients they employ, to compoſe a ſingle medicine. For moſt of the arguments that ſhew the advantage of ſimple remedies, are alſo applicable to chymical ones.

In many caſes, preparations, ſkilfully diverſifyed, may be uſefully ſubſtituted for compoſition; ſince one body dextrouſly expoſed to different operations, may acquire as various, or as conſiderable qualities, as would accrue to it by the addition of ſuch other materials, as an ordinary chymiſt would, in all probability, aſſociate with it. Thus, not to mention quick-ſilver, antimony alone, or aſſociated with one or two ingredients, may afford a variety of medicines, capable almoſt of furniſhing a ſhop; or, at leaſt, to anſwer the phyſician's intention, when he would employ an emetic, a cathartic, a diaphoretic, a deobſtruent, a diuretic, a bezoardic, or cordial medicine; to paſs over the other remarkable qualities that may be found in ſome antimonial preparations.

Again, without bringing together a chaos, or any great number of ingredients, one or two auxiliary ones, if judiciouſly choſen, and ſkilfully managed, may often produce more efficacious remedies, than the admirers of pompous proceſſes would expect. The violently emetic, and purgative virtue of glaſs of antimony, *per ſe*, may be, as we have ſeen, more powerfully corrected by mere diſtilled vinegar, than by many famous ſtomachic, or cordial elixirs, and other eloborate preparations. And, ſometimes, a ſeemingly improper addition may not only correct, but give new and unexpected virtues to a drug. Thus, tho' corroſive ſublimate be a very pernicious and fretting mercurial concrete, yet by adding, and carefully uniting to it, an equal weight of running mercury, there is thence, by ſublimation, obtained a compound, which, in ſkilful hands, may be uſefully employed, not only in ſome venereal affections, but in ſeveral other diſtempers. And this preparation, call'd *Mercurius dulcis*, being carefully made and apply'd, will greatly allay even the ſharpneſs both of ſome emptying medicines, and of ſome peccant humours. I remember, I had an opportunity to obſerve its efficacy in a ſtubborn dyſentery, that had baffled the remedies of an eminent phyſician. But, tho' a reflexion on the virtue I knew this medicine to have, in allaying ſharp humours, and reſiſting putrefaction, might juſtly give me a favourable opinion of it in this caſe; yet not thinking my own experience ſufficient, I imparted it to an ancient and experienced chirurgeon of the army, who frankly confeſs'd, that this was his great *Arcanum*, wherewith he had cured many hundreds of ſoldiers of the like diſtemper. But, as my way is to give from eight to fifteen grains of it, for a doſe, made up with a little rhubarb, or other ingredient, that would make it work once or twice; (for the dyſentery it ſelf helps to carry off the medicine) he made it up with ſugar and the mucilage of gum-dragon, into lozenges; each whereof might contain from near a ſcruple

MEDICINE. to half a dram, of the *Mercurius dulcis*: and of theſe he order'd the ſoldiers to take one at a time, without hindering their march; only giving them a great caution, that nothing of it ſhould ſtick between their teeth, or in their throats.

But the efficacy of this ſimple preparation of mercury, is much inferior to that more ſimple one of gold, made after the ſame manner, in two different countries, by two dextrous phyſicians, both of them my acquaintance. For, tho' I had been long prejudiced againſt the pretended *Aurum potabile*, and other boaſted preparations of gold, for moſt of which I have ſtill no great eſteem; yet I ſaw ſuch extraordinary and ſurprizing effects from the tincture of gold I ſpeak of, upon perſons of great note, with whom I was particularly acquainted, both before they fell deſperately ſick, and after their ſtrange recovery; that I could not but change my opinion for a very favourable one, as to ſome preparations of gold. But tho' this ſimple medicine can only be made in ſmall quantities, and that too not without a great deal of pains and time, I can ſpeak thus circumſtantially of it, becauſe by the kindneſs of the artiſts, and the pains I had beſtowed in working upon the ſame ſubject they uſe for their menſtruum, I ſo far knew, and partly ſaw the preparation of it, as to apply what has been ſaid, to the preſent occaſion. There is here but a ſingle ingredient aſſociated to the gold, and that comes from above, and is reputed one of the ſimpleſt bodies in nature; two or three ounces of which may be taken altogether unprepared, without the leaſt inconvenience. Yet the doſe of this almoſt inſipid medicine, that was given to an old courtier in a violent apoplexy, after other remedies had by ſkilful men been uſed in vain, was but ſix or eight drops.

In another very ancient and corpulent perſon, the doſe was greater; the tincture being then more unripe, and diluted: but the effect was as ſudden, tho' the patient were not bled; and tho' there was not in either of theſe caſes any remarkably ſenſible evacuation made. The two perſons thus recover'd are yet alive. The ſame medicine, a while after, ſaved the life of another gentleman, whom I knew, that having lain above two and twenty days ſick of an ill-conditioned fever, was condemned by three phyſicians; one whereof told me, that he could not out-live the next morning; yet, upon taking of a large doſe of this tincture, he was preſently relieved; and from that time found a ſenſible amendment, and afterwards recover'd his health, which he now enjoys, tho' he was then reputed to be fourſcore years old. I could relate ſome other odd effects of this remedy; but the preſent may ſuffice to alleviate a prejudice againſt medicines, made of ſo fixed and ſuppoſed unalterable a metal as gold.

Nor is this the only medicine, made of that noble body, of which I have known very remarkable effects. My preparation of ſilver, tho' it may ſeem but ſlight, has proved very effectual, and been much uſed by one of the moſt eminent phyſicians of this nation, to whom

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MEDICINE. ſaid of mercury; witneſs the remedy, formerly commended againſt worms, made of nothing but crude quick-ſilver, barely boiled in common water: and the calx of lead, diſſolv'd in ſpirit of vinegar, affords *Saccharum Saturni*; which, tho' ſo eaſy and ſimple a preparation, is a magiſtery that has more virtues than every phyſician knows, or, perhaps, ſuſpects; eſpecially in mortifying ſharp humours in the eyes; which I have known it ſometimes do, almoſt in a trice, when well diluted with plantain, or roſe-water. And for burns, I have ſeldom ſeen any thing equal to it; and, therefore, have often uſed it upon my ſelf, barely diſſolv'd in common water: but, I fear, 'tis not ſo ſafe, as effectual, in ſome internal diſorders of the *viſcera*, judg'd to proceed from acid humours, unleſs it be warily and ſkilfully given. But, as to its external uſe, it is very powerful in healing, and, in the mean time, appeaſing the pains of ſeveral ſorts of ulcers. A very ancient, and experienc'd chirurgeon, confeſs'd to me, that of all the medicines he has tried to ſtop bleeding, and prevent accidents in amputations; that which he moſt rely'd on, was a ſolution of *Saccharum Saturni*, in plantain, or common water. His method is, to diſſolve an ounce of the former, in about a pint of the latter; and as ſoon as ever the limb is taken off, immediately to apply ſtupes, drench'd in this liquor, as hot as the patient can well endure: and having bound them carefully on, he makes no haſt to take them off, but allows the medicine time enough to perform its operation.

What is here ſaid of metals, may be extended to minerals; for when there is need to compound them, it may often be ſufficient to aſſociate them with one or two auxiliary ingredients. This appears from ſeveral uſeful preparations of antimony, commonly known; to which ſeveral others may be added, that are made by ſlight additions of common ſulphur. But of this ſort I ſhall only mention one, whoſe medicinal virtues are very great, eſpecially in aſthma's and coughs, in which I do not remember, that I ever gave it, without benefit to the patient; nor was it leſs ſucceſsful in the hands of phyſicians, who were willing to try it for me; eſpecially in thoſe of a perſon, who, tho' well furniſh'd with choice remedies of his own, often came to me for a ſupply of this ſpirituous and penetrating tincture, with which he aſſured me he did notable things in aſthmatical caſes; and particularly in one, that was very obſtinate, and had laſted many years. This medicine is made of the flowers of ſulphur, exactly mix'd with an equal weight of ſal-armoniac, and more than an equal weight of good quick-lime, ſeparately reduced to fine powder. Theſe three ingredients being diligently and nimbly mix'd, and put into a retort, fitted with a large receiver, well luted to it, and duly diſtill'd in a ſand-heat, will afford a blood-red and ſmoaking ſpirit, exceeding ſulphureous, both in ſmell and mechanical operations. And, in this diſtillation, we found the ſulphureous parts ſometimes came over accompanied with ſuch ſtore of ſaline ones, that a good part of

what

what paſs'd into the receiver, ſhot into the form of a volatile, ſulphureous ſalt.

Whether ſimple remedies may cure complex diſtempers.

7. It may be objected, againſt the frequent uſe of ſimple medicines, that a diſeaſe, or the morbific matter, is, often, not the effect of a ſingle cauſe, but produc'd by the concurrence of two or more, which, creating ſeveral ſymptoms, 'tis improbable that one ſimple will be able to anſwer the ſeveral indications. This objection is, I confeſs, conſiderable; and there are caſes, wherein I acknowledge it to be ſo weighty, as to warrant a phyſician to employ a medicine, conſiſting of ſeveral ingredients. But this interferes not with my deſign; ſince I formerly declar'd, I was not for confining any one to ſimple remedies, but wiſh phyſicians would only employ them where they may ſuffice.

Two or three conſiderations may, however, be offer'd, to leſſen the force of the preſent objection. And firſt, I readily grant, that ſometimes diſeaſes may proceed from different cauſes; and that a remedy may be available againſt them, when produced by one of thoſe cauſes, without being ſo when they flow from another; yet it may eaſily happen, that in one caſe the diſeaſe may be cured by one ſingle medicine, and in another, by a remedy not compounded. Nay, it is poſſible, the ſame ſimple may cure a diſtemper, by which ſoever of the two cauſes it is produced. And the effects of the *Peruvian* bark, in different kinds of agues, and of narcotic medicines, in appeaſing pains produced by humours, and other very different cauſes, render this aſſertion probable. And, if I miſtake not, it may frequently happen, that, whatever firſt produced a portion of morbific matter, this very matter may cauſe the continuance of the diſeaſe, by means of ſome peculiar texture, or noxious conſtitution, which if the generous medicine can deſtroy, the diſeaſe will ceaſe.

It often happens, that ſeveral very different ſymptoms may ſo depend upon the primary cauſe of the diſeaſe, that if a medicine, how ſimple ſoever, be able to deſtroy that cauſe, all the various ſymptoms will vaniſh of themſelves. Thus we ſee, that when mercury is ſkilfully apply'd, and raiſes a kindly ſalivation, a great variety of inconveniencies, that afflicted a venereal patient, and ſeem'd to require many different and topical applications, are remov'd by the ſame remedy; ſo that not only frightful ulcers, but ſuch nodes as one would think ſcarce poſſible to be diſſipated by the ſtrongeſt plaiſters, are ſometimes happily cured by well-prepared quick-ſilver, taken at the mouth. And tho' there are ſeveral, and, ſometimes, very different ſymptoms, that accompany the rickets; yet the medicine, which I call *Ens veneris*, made of ſtrongly calcin'd, and well dulcify'd colcothar of *Dantzic* vitriol, and elevated with ſal-armoniac into the form of a reddiſh ſublimate, has prov'd ſo ſucceſsful, that I think I may ſafely ſay, two or three hundred children have, through my means, been

cured:

MEDICINE. cured by it, and that, almoſt always without the help of any other inward medicine, or topical application.

But the principal thing I oppoſe, by way of anſwer, to the objection is, that in a ſimple medicine, nature, her ſelf, often renders the uſe of compoſitions unneceſſary; for tho' we are apt to look upon a plant, or mineral, as an entire and ſimple body, yet we may greatly miſtake, if we look upon it as homogeneous. In ſeveral plants, that are organical bodies, as, for inſtance, in oranges, the ſucculent part is ſour and cooling, but the yellow rind conſiderably hot and bitter; and ſo in lemmons, the pulp, the yellow part of the rind, and the ſeeds, have their different qualities and medicinal virtues: and even in ſuch vegetable ſubſtances, as are homogeneous as to ſenſe, there may be parts, whoſe operations are not only different, but contrary; as is manifeſt in rhubarb, which affords as well aſtringent as purgative parts. This holds, alſo, in minerals; thus good clean lead-ore, for inſtance, tho' an uniform body, as to ſenſe, conſiſts of very diſſimilar parts, and affords ſulphureous, and, perhaps, other recrements, beſides malleable lead, which is of it ſelf a compound body. Thus, alſo, ſhining marcaſites, tho' they appear homogeneous, will, by being barely expos'd, for a competent time, to the moiſt air, afford an efflorеſcence perfectly vitriolate; and conſequently contains an acid ſalt, two kinds of ſulphur, a terreſtrial matter, and, at leaſt, one metal; which latter ſubſtances themſelves, are neither of them ſimple bodies.

And if we admit the chymical analyſis of mix'd bodies to be genuine; we ſhall find that almoſt all thoſe belonging to the vegetable kingdom, or to the animal, and many that are referred to the mineral kingdom, how uniform ſoever they may appear to the eye, do each of them, contain different, and ſometimes oppoſite ſubſtances. Thus hartſhorn, tho' it appears a dry and homogeneous matter, will, in diſtillation, afford a volatile ſalt, an urinous ſpirit, a wateriſh liquor, or phlegm, an oil that will ſwim, and another that will ſink in water, a white and porous earth, or *terra damnata*, and, perhaps, ſome fix'd ſalt. Thus, alſo, in the vegetable kingdom, tartar, for inſtance, may, without addition, be made to afford a volatile ſalt, very like that of urine, a phlegm, an acid ſpirit, another ſpirit, which I call adiaphorous, two fetid oils, whereof one will ſink in water, and the other ſwim, a *terra damnata*, and a fix'd lixivial ſalt, upon which the acid ſpirit manifeſts ſuch an hoſtility, that when put together, they tumultuate, with noiſe and bubbles, and in the conflict, mortify each other. So, likewiſe, in the mineral kingdom, we ſee native cinnabar affords, by diſtillation, beſides running mercury, a dry ſubſtance, whence I have obtain'd a ſulphur, that would, preſently, gild ſilver, and a terreſtrial matter, whoſe nature I did not examine. And I the rather take notice of theſe differing parts, in native cinnabar, becauſe it is a mineral that I much eſteem; and tho' here in *England* it is very rarely employ'd as an internal medicine, yet I know ſome phyſicians,

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MEDICINE. tent time. 'Tis not, indeed, every efficacious ſimple, or lightly compounded remedy, that can be fitly employed for the proof of our doctrine; I ſhall, therefore, ſubjoin a few ſuch inſtances, as may ſuffice for the preſent occaſion.

Mineral waters, whether *Acidulæ*, as thoſe of the *German Spaw*, our *Tunbridge*, &c. or *Thermæ*, ſuch as thoſe of *Bath*, &c. tho' but natural medicines, are, ſome of them, by being outwardly adminiſtred, known, ſingly, and in their native ſimplicity; to cure ſeveral diſeaſes; and, conſequently, to take off a great number of different ſymptoms, which afford various indications. That the ſame ſimple may comprize qualities fit to anſwer different deſigns, and, therefore, cure different ſymptoms, ſeems probable; becauſe ſeveral poiſons, that do, each of them, produce various frightful ſymptoms, all which have been often conquer'd by a ſpecific antidote, that is, perhaps, but a ſimple herb, or other uncompounded drug.

Phyſicians, and others, have obſerved great variety of ſymptoms in the plague; among which there are ſeveral, each whereof, if ſingle, would paſs for a particular diſeaſe; and this diverſity of ſymptoms may be often obſerved, not only in peſtilences, that happen at times, or countries, diſtant from one another, but in the ſame plague reigning in the ſame place. Yet 'tis poſſible for a ſimple remedy to prove available againſt this ſo various and violent a diſeaſe. *Galen* himſelf, treating of the *Terra Samia*, takes occaſion to bring in the virtues of *Bolus Armena*. This earth, which appears ſo ſimple and uniform, he not only commends for ſeveral diſeaſes, as ſpitting of blood, fluxes of the belly, dyſenteries, catarrhs, defluxions, difficulty of breathing, and even ulcers of the lungs; but adds, what makes directly for our purpoſe, that "in a very ſevere plague, all who took this medicine early, "recover'd." "'Twas taken," he ſays, "mix'd with ſmall white-"wine, diluted in proportion to the fever." He alſo declares, that "if this remedy failed to relieve the patient, every thing elſe proved "ineffectual."

There are few diſeaſes that appear in ſo many forms, with greater variety of ſymptoms, than that which phyſicians call *Affectio Hyſterica*, whoſe paroxyſms are vulgarly known in *England* by the name of fits of the mother: yet we have often ſuddenly removed theſe fits, by the bare odour of ſpirit of ſal-armoniac.

But to ſhew the efficacy even of dry and ſolid bodies, tho' but externally apply'd, in diſeaſes, attended with many uncommon ſymptoms, we might have recourſe to the ſtones, ſaid to be found in the heads of a certain kind of ſerpents about *Goa*, and ſome other *Eaſtern* countries. Moſt phyſicians, however, reject or queſtion the power aſcribed to them, for curing the bites of vipers: and, indeed, many of the ſtones brought from *India*, are counterfeit; and of thoſe that were really taken out of ſerpents, ſeveral will prove inſignificant; (and ſuch, perhaps, were thoſe that the learned *Rhedy* made his trials with;) yet there

there are others, whoſe virtues cannot well be deny'd. For one of the moſt eminent phyſicians of the *London* college aſſured me, he had with one of theſe ſtones, contrary to his expectation, performed a notable cure, which he related to me, at large. And a very famous *Engliſh* chirurgeon affirmed to me, that he had done the like upon another perſon; both of theſe cures being performed by the bare application of the ſtone, to the place bitten by the viper. A very intelligent perſon, alſo, who had the direction of a conſiderable company of traders in *Eaſt-India*, where he long lived, aſſured me, he had with this ſtone cured ſeveral perſons of the hurts of venomous animals. But this teſtimony is much leſs conſiderable, as to the number of cures, than that of a great traveller into the ſouthern parts of the ſame *India*; who ſeriouſly aſſured me, he had cured above ſixty perſons of the bites or ſtings of ſeveral ſorts of poiſonous creatures; and that he performed moſt of thoſe cures by the outward application of one ſtone; becauſe, finding it excellent, he was invited to keep to it, eſpecially in difficult caſes. And this, ſome experience of my own, made with a genuine ſtone of the ſame kind, upon the bodies of brutes, much inclines me to give credit to.

I had once the opportunity of making a trial of the virtue of a ſtone, taken out of the head of an enormouſly great *African* ſerpent. This ſtone was affirmed to its poſſeſſor, the governour of the *Engliſh Eaſt-India* company, to be highly available againſt the bites of all venemous animals. And, indeed, a little of it recover'd a cat from two dangerous bites of a fierce and enraged viper, after we had deſpaired of his life, on account of the violent ſymptoms that enſued.

But becauſe this ſtone is afforded by an animal, I ſhall, for a concluſion, add the virtues of another, that properly belongs to the mineral kingdom, in a diſeaſe, whoſe ſymptoms, tho' not ſo various, are ſometimes dangerous, and too often mortal.

There was once ſhewed to me a cloſe and hard ſolid body, which paſs'd for a blood-ſtone, tho' by its colour, and ſome other viſible qualities, I ſhould rather have taken it for agate, about the bigneſs of a ſmall nutmeg, that had been kept long in the family wherein I ſaw it; being, for its rare virtues, tranſmitted from one to another. I ſhall not relate all the reports made of this ſtone; but I think the following particular of it is very remarkable. An ingenious gentleman, in the flower of his age, and of a complexion very highly ſanguine, was, from time to time, ſubject to hemorrhages at the noſe, ſo profuſe and difficult to be reſtrained, that his phyſician, tho' a perſon famous, and very well ſkill'd in his art, told me, he often fear'd he ſhould loſe his patient. But when a good method, and variety of remedies had been try'd, without the deſired ſucceſs, this ſtone was, at length, obtained to tie about his neck, ſo as to touch his naked ſkin; which being done in the fits, it would ſtop the bleeding; and if he wore it for ſome conſiderable time together, he all that while continued well; as both his

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phyſician, and himſelf informed me. And becauſe I was apt to aſcribe ſomewhat of this effect to imagination, the patient told me, that a while before, one of the chief women in the city fell into ſo violent a bleeding, that tho' it made her ſwoon, yet the hemorrage ſtill continued, till the ſtone having been tied about her neck, ſtopp'd it; whilſt ſhe knew nothing of its being apply'd. And this is ſtill leſs ſtrange, than what the gentleman affirm'd to me of the power of the ſame ſtone; for his complexion inclining him to breed great plenty of blood, his phyſician order'd him, by way of prevention, to breathe a vein from time to time; but in preparing for this operation, he was obliged to lay aſide the ſtone, becauſe the blood would not otherwiſe iſſue with the requiſite freedom.

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MEDICINE. to be too light; which, tho' it appear'd improbable, yet having cauſed the room to be a little darken'd, I then perceiv'd he could read well enough.

4. A gentleman having received a violent blow on the ſide of his head, found, afterwards, a great weakneſs and dimneſs of ſight to enſue; and looking attentively upon his eyes, I plainly diſcern'd, that tho' above half the pupil of one eye remain'd uncover'd; ſo that when he look'd downwards, he could ſee very well with that eye; yet there were grown in it two cataracts, which, when carefully view'd in a good light, I plainly perceived to be diſtinct; the one of them ſeeming to be ſmoothly ſpread, as if its circular edge adhered cloſely to the inſide of the eye; the other, which ſeem'd not quite of the ſame colour, hanging looſely, and like a rag, at ſome diſtance above it.

Objects appearing dark and double.

5. A learned gentleman coming once to viſit me, with deſign to learn my opinion, concerning an odd diſtemper he had in his eyes; I found, by diſcourſing with him, that tho', when he look'd on things near at hand, he ſaw them ſomewhat dimly, but ſingle; yet there were ſome objects, particularly poſts and rails, which when he beheld at a certain ſmall diſtance, they appear'd to him both dark and double. He alſo complain'd of many black flies, and little leaves, which paſs'd, now and then, before his eyes; which tho' they do not always foretel a true cataract; ſince I have obſerv'd them to continue many years without more than a baſtard ſuffuſion enſuing; yet in him they were, probably, fore-runners of a true cataract; becauſe I have known it obſerv'd, by a ſkilful oculiſt, that perſons, before the formation of their cataract, have complain'd they ſaw objects at ſome diſtances almoſt double; ſo that looking at the head of a man, they thought they ſaw a great part of a dark head a little above it: which phenomenon, whether it proceed from ſome refractions made by the yet unequally opake matter of the cataract, not having opportunity to examine, I dare not venture to ſay.

Cataracts happily couched.

6. It may be worth obſerving, how long the more kindly ſort of cataracts, tho' they hinder the ſight for a time, as a thick curtain drawn over the pupil, may remain in the eye, without ſpoiling the optic nerve, or deſtroying viſion, after the diſtemper is remov'd. I remember, among other inſtances, a woman told me ſhe had cataracts in her eyes ſo long, that ſhe was deliver'd of ſix children, ſucceſſively, without being able to ſee any one of them, till after ſhe had been couch'd; upon which, ſhe could read a ſmall print, with ſpectacles. And ſeveral conſiderable perſons, of my acquaintance, ſaw one, of eighteen years old, born with cataracts in both her eyes, who had been ſo happily couch'd, as thence to receive the benefit of ſight in them both.

Both eyes concern'd in real viſion.

7. It has, of late, been the opinion of very learned men, that tho' both our eyes are open, and turn'd towards an object, yet but one of them at a time, is effectually employ'd, in giving us the true repreſentation

ſentation of it. But there will be a variation herein, according to the ſeveral habits and conſtitutions of the eyes of different perſons. For I have, by an experiment, purpoſely made, ſeveral times found, that my two eyes together, beheld an object in another ſituation, than either of them apart would do. On the contrary, I met with a perſon, who told me he had a cataract in his eyes, for two or three years, without finding any impediment in his ſight; tho' others had, during that time, taken notice of a white film that croſs'd his eye, till, at length, happening to rub his ſound eye, he was ſurpriz'd to find himſelf in the dark; upon which, an oculiſt aſſured him, it was a cataract. But a very ingenious perſon had, by an accident, one of his eyes ſtruck out, who told me, that, for ſome months after, he was apt to miſtake the ſituation and diſtance of things; for, having frequent occaſion to pour liquors out of one vial into another, after his misfortune, he often ſpilt them, and let them run quite beſide the necks of the vials, he thought he was pouring them directly into. Another gentleman, alſo, who had, by a wound, loſt the uſe of one of his eyes, confeſs'd to me, that, for ſome time after, he often, in pouring out his wine, miſs'd the mouth of the bottle or glaſs, that ſhould receive it. A yet more conſiderable inſtance, of this kind, I met with in a noble perſon, who, in a fight, had one of his eyes ſtrangely mangled by a muſket-ball, which came out at his mouth; for he told me, that he could not well pour drink out of one veſſel into another, and had broken many glaſſes by letting them fall out of his hand, when he thought he had given them to another, or ſet them down upon the table: he added, that this aptneſs to misjudge of diſtances and ſituation, continued with him, tho' not in the ſame degree, for little leſs than two years. I have often employ'd a dextrous artificer, whoſe right eye is conſtantly drawn ſo much aſide, towards the greater angle, that the edge of the pupil, almoſt, touches it; whence one would think it ſcarce poſſible, but he ſhould ſee objects double with two eyes, that ſeem ſo very differently turn'd; for the other remains natural; yet he finds no inconvenience from hence, except deformity, for he reads as freely as other men. This diſorder befel him thro' miſtaking ſublimate for another thing; after which, it ſeems, one of the muſcles, that moved the eye, remain'd contracted. But as he had been thus, ever ſince he was two years of age, he could not remember whether he had ſeen objects double, before he was accuſtomed to judge of them by the help of his other ſenſes, and the information of others.

The parts of the eye capable of great dilatation, without prejudice.

8. 'Tis worth obſerving, that a very great diſtention may be made of the parts of the eye, without ſpoiling of the ſight. Of this I lately ſaw an inſtance in a patient of that experienced oculiſt, Dr. *Turbervill.* A gentlewoman about two and twenty years of age, whoſe complexion and features would have render'd her handſome, had it not been for that ſort of eyes which ſome call ox-eyes; for they were ſwelled ſo much beyond

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beyond the ſize of human eyes, that ſhe complain'd they often frighted thoſe who ſaw her; and were, indeed, ſo big, that ſhe could not move them to the right hand, or the left, but was obliged to look ſtreight forward; or if ſhe would ſee an object that lay on one ſide, ſhe was oblig'd to turn her whole head that way. And this was her caſe when ſhe went to read; unleſs, with her hand, ſhe mov'd the book from one ſide to another, to bring the ends of the lines directly before her eyes. She ſaid her eyes were not always equally tumid, and that the day I ſaw them, they had been, in the morning, much more ſwell'd. But, what is more remarkable, ſhe could, for all this, not only ſee very well and diſtinctly, but her ſight continued good, tho' this diſtemper had been upon her for twelve years. Nay, ſhe declar'd, that when this diſorder firſt came on, ſhe knew of nothing that was amiſs in her eyes, till her friends told her of it, after they found it of too long a continuance to be a caſual tumour. It, however, occaſioned great pain in her eyes; for which ſhe took ſeveral medicines with ſo little ſucceſs, that both ſhe, and her former phyſicians, thought the caſe deſperate: upon which I propos'd a ſalivation; but the modeſt patient would by no means conſent to it.

A dimneſs of ſight in the day-time.

9. I once look'd into the eyes of a gentlewoman, where I could diſcern nothing amiſs, or unuſual, except the narrowneſs of her pupils, which is often eſteem'd a good ſign; yet ſhe was much troubled with fumes, and weakneſs in her head; and had a very uncommon diſorder in her ſight: for in the day time, ſhe ſaid it was ſo dim, that ſhe could hardly diſcern her way; but that ſoon after ſun-ſet, and during the twilight, ſhe ſaw far better: and thus ſhe continued for a long time. This brings to mind an odd caſe of an old learned divine, who complain'd to me, that, during the day-time, his right hand ſhook ſo much, that he could not manage his pen; and, therefore, was forc'd to make uſe of it only by candle-light. I remember, that upon his preſſing me to aſſign ſome poſſible cauſe of ſo odd a phenomenon, I told him, to put him off, that, perhaps, the few animal ſpirits he had to move his hands with, were ſo ſubtile, as to be diſſipated, or exhal'd, by the warmth of the day, but were kept in by the coldneſs of the night, that conſtipated the pores; and thereupon recommended to him the uſe of ſtrengthening things; and among the reſt, of chocolate; which, having continued to drink, for ſome time, he came and told me, with joy, that he began again to be able to write in the day; and ſo, I think, he ſtill continues to do.

The appearance of fire paſſing before the eyes.

10. Being acquainted with two ladies, of very different ages, but very near of kin, who were both of them troubled with diſtempers, that made me gueſs their eyes might, ſometimes, be oddly afflicted; I learnt, upon inquiry, that one of them, often thought ſhe ſaw numberleſs ſparks of fire, that were very unwelcome to her; and the other, who was ſubject to convulſions, tho' not epileptic, told me, ſhe fre-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE. of them in aſtronomical obſervations, and optical experiments, yet he confeſs'd to me, that there are ſome colours which he conſtantly ſees amiſs; and particularly inſtanced in one which ſeemed dark to him, whilſt to me and others it appear'd quite different.

13. A lady, who has been long troubled with a very unuſual diſorder in her head, and who, tho' ſhe looks well, is never without pain in that part, told me, that after violent fits hereof, which ſhe has ſuffer'd from time to time, if ſhe did but turn her eyes, ſuddenly, from one ſide to the other, a convulſive motion in one of them would preſently enſue; upon which, all white objects, and moſt others ſhe look'd on with that eye, appeared green. And yet this was not a tranſient diſcompoſure that would go quickly off, but continued for a good while, and frequently return'd upon her, for a whole year together; ſo that ſhe deſpair'd of recovering the uſe of that eye, wherewith ſhe, nevertheleſs, ſees now very well; tho' her cephalic diſtempers are not quite cured. And if ſhe goes to read whilſt the convulſion is upon her, the letters are ſo apt to appear double, that if ſhe reſolves to continue reading, ſhe is oblig'd to ſhut the diſtemper'd eye, and employ only the other.

A great dilatation of the pupilla in the dark.

14. There was a gentleman of great courage and good parts, major to one of the regiments of king *Charles* I; who being afterwards forc'd abroad, ventur'd, at *Madrid*, to do his king a piece of ſervice, of an extraordinary nature and conſequence, and there judg'd very irregular. Upon this he was committed to an uncommon priſon, which had no window belonging to it, only a hole in the wall, at which the keeper put in proviſion, and preſently clos'd it again on the outſide; but not perhaps very exactly. For ſome weeks, this gentleman continued in the dark, very diſconſolate, but afterwards he began to think he ſaw ſome little glimmering of light, which, from time to time, increaſed ſo, that he could not only diſcover the parts of his bed, and other ſuch large objects, but, at length, perceived the mice that frequented his chamber, to eat the crumbs of bread which fell upon the ground, and diſcern'd their motions very well. Several other particulars of his ſight in that dark place he related; but when, after ſome months, the face of affairs was changed, and this gentleman ſet at liberty, he durſt not leave his priſon on the ſudden, for fear of loſing his ſight by the dazzling light of the day; and, therefore, accuſtomed his eyes to it by ſlow degrees. This relation I had from the gentleman's own mouth.

A

COLLECTION

OF

REMEDIES,

Gain'd from particular experiments, made in the curative part of medicine.

MEDICINE.

The nature and design of this collection.

THIS here my design to communicate the receipts of such medicines, as, by competent experience, have been found serviceable. Physic, indeed, is not my profession, yet I hope I may publish a collection of remedies, without incurring the censure of equitable persons; since 'twas a regard to the good of mankind that induced me to it. And did such a practice stand in need of precedents and examples to patronize it, very eminent persons, both among the ancients and moderns, would abundantly afford them.

The major part of the following receipts is, chiefly, design'd for the use of the generality, and those who cannot well procure the assistance of a physician; and because such persons are more frequently exposed to external injuries, as strains, bruises, tumours, *&c.* I purposely procured, from eminent surgeons and practitioners, a number of remedies, that, having been found very effectual in such cases, might be useful in this collection. However, I am not so much an empiric, as to recommend any remedies for certain and infallible cures, in the cases wherein they are proper. He must either be very happy, or very little versed in physic, who has never found the most celebrated medicines ineffectual. And, indeed, the causes and complications of diseases, and the constitutions of patients, are so various, intricate, and obscure, that 'tis extremely difficult, for the most experienced physician, to make an accurate expe-

MEDICINE. riment in the curative part of his profeſſion. I, therefore, ſolemnly profeſs, that I do not ſet down medicinal experiments, with the ſame poſitiveneſs I do thoſe in philoſophy; nor venture my reputation upon the ſucceſs of any receipt, or proceſs in medicine. Theſe, however, I always deliver faithfully; nor have I, upon uncertain rumours, recorded the virtues of particular remedies; which may be good without being infallible. And we muſt not be ſo weak, or fearful, as to perſuade our ſelves, if a patient miſcarries after the uſe of remedies, that the fault was in the medicine. For, in ſpite of our endeavours, the peccant matter will often be tranſlated, and the conſtitution impair'd; and the conflict of ſtruggling nature, and the conquering diſeaſe, muſt ſometimes manifeſt it ſelf in horrid ſymptoms; which the envious, or ignorant, unjuſtly aſcribe to the remedy: not conſidering that the like phenomena attend deſperate diſeaſes, and dying perſons, where no remedies at all are adminiſtred.

I muſt further declare, that I do not pretend the remedies I communicate, ſhould be phyſic and phyſician too; or of themſelves cure the diſeaſes for which they are recommended. For, medicines are but inſtruments in the hands of a phyſician, and require ſkill to manage them. I am, therefore, ſurprized at their boldneſs, who venture to practiſe phyſic barely upon the confidence of good receipts. Whoever acts as a phyſician, ſhould, at leaſt, have a competent knowledge of anatomy, the hiſtory of diſeaſes, of the *Materia medica*, and the chief ways of compounding ſeveral ingredients into medicines, of different forms and conſiſtencies, as circumſtances may require. He who has only one good receipt for a diſtemper, and knows not how to vary it, by occaſionally adding, omitting, or ſubſtituting other parts of the *Materia medica*, muſt frequently ſuffer his patient to languiſh helpleſs; or attempt to cure him of one diſeaſe, by throwing him into another. I know, for inſtance, ſome eminent phyſicians, who cure very ſtubborn venereal caſes, by a chymical preparation of ſarſaparilla, guaiacum, *&c.* but if theſe gentlemen meet with ſuch patients, as *Euſtachius Rudius* often did, to whom guaiacum would immediately give ſo great a ſharpneſs of urine, and inflammation of the urinary parts, as to hazard their lives; they muſt be reduced, as well as he was, to uſe mercurial, or other remedies.

It, alſo, ſometimes happens, that the very form of the medicine order'd in the receipt, renders it unfit, or impoſſible to be adminiſtred. A phyſician of my acquaintance was call'd to a patient, ſeiz'd with ſuch a conſtriction of the parts ſerving to deglutition and ſpeech, as render'd her wholly unable either to ſwallow, or to ſpeak; and thus ſhe continued for ſeveral days, notwithſtanding ſome emetic preparations that were put into her mouth; till, at length, a glyſter was luckily preſcribed, with four ounces of the infuſion of *Crocus metallorum*; upon which, there ſoon followed ſome violent vomitings, and a freedom of

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Medicinal Experiments.

For ſcorbutic aches, eſpecially about the ſhare-bone.

3. Take two parts of palm-oil, and one of oil of camomile; mix theſe exactly, and therewith anoint the part affected.

A powerful remedy for ſcorbutick aches.

4. To one ounce of oil of turpentine, put one dram or two, of the volatile ſalt of hartſhorn, or as much as, being well ground with it in a marble mortar, will bring it to the conſiſtence of a kind of ointment; with which, the cold being taken off, the part affected is to be lightly anointed.

For ſlight ſcorbutic aches or pains.

5. Anoint the pained part, from time to time, with faſting ſpittle; and if you will have the medicine a little ſtronger, the patient may put roach-alum, to the bigneſs of a ſmall pea, into his mouth, before he employs his ſpittle.

For aches, and pricking pains in the ſides, or elſewhere.

6. With a ſufficient quantity of clean ſulphur, finely powder'd, mix as much *Venice*-treacle, as will bring it to a conſiſtence for pills. Of this mixture you may give the quantity of a piſtol-bullet, twice or thrice a day; drinking any convenient liquor after it.

For acidities in the blood.

Acidities. 7. Take coral, the cleareſt and reddeſt you can get, and reduce it to an impalpable powder. Of this give the patient, once or twice a day, as need ſhall require, about one dram at a time; and let him long continue the uſe of it.

To bring away the after-birth.

After-birth. 8. Give about 30 drops, or any number between 25 and 35, of good eſſential oil of juniper, in a draught of any convenient vehicle.

An external medicine, often ſucceſsfully try'd for agues.

Agues. 9. Take five, ſeven, or nine (for 'tis pretended it muſt be an odd number) of the roots of rib-wort; and having made them clean, put them into a little bag of ſarſenet, or fine linen, and let the patient wear it upon the nape of his neck; renewing it within two, three, or four days, if need require.

A try'd remedy for agues.

10. Take of the bark of ſaſſafras-root, and of *Virginia* ſnake-weed, both in powder, of each ten grains; and with half a dram, or two ſcruples of mithridate, or *Venice*-treacle, make a bolus; to be taken two hours before the cold fit.

A choice

MEDICINE.

A choice medicine for aguish distempers.

11. Take of salt of wormwood fifteen grains, crabs eyes eight or ten grains; mix these well, and give them in two or three spoons-full of some cordial-water.

A wrist-plaister for agues.

12. Spread wax, to about the thickness of a crown-piece, and of a convenient breadth and length, to make an entire wrist-plaister; upon this display the leaves of the tops of rue, not yet fully open'd, so that they may cover the whole plaister; then apply it, and let it lie on for several days, successively.

An often try'd medicine for agues.

13. Gather the leaves of rib-wort, as near the root as you can, in a dry morning; wipe them clean, but do not wash them; then dry them carefully, till you may reduce them to powder. Of this give from one dram to two, mixt with one dram of conserve of roses, the crumbs of white bread, or the yolk of an egg or two.

For agues, especially tertians.

14. Give as much *Virginia* snake-root, reduced to fine powder, as will lie upon a shilling, in a glass of sherry, just before the beginning of the cold fit; repeating it once or twice if need be.

For a tertian ague.

15. Of the root of angelica powder'd, give from half a dram to a dram, in any convenient vehicle, about two hours before the cold fit.

A medicine with which a quartan was cur'd, when the bark had fail'd.

16. Let the patient take one dram of the black tips of crabs-claws, reduc'd to exceeding fine powder, in any convenient vehicle or conserve, twice or thrice a day, as he would take the *cortex*, without intermitting.

To prevent or cure an ague.

17. Take grated angelica-root, flowers of antimony, of each half a dram, canary three ounces: infuse them in a cold place for two days, and pour off the clear for two doses. It is a singular good vomit for the cure of agues of all sorts, being given in the morning fasting, four or six hours before the fit; and if it be not a quotidian ague, on the intermitting day.

An often try'd pericarpium for agues, especially tertians.

18. Take a handful and a half of fresh rue, half a handful of fresh sage, a small spoonfull of bay-salt, and a spoonfull of good vinegar. Beat all these very well together into an uniform mass; which divide into

MEDICINE. into two parts; and make thereof two wriſt-plaiſters; to be apply'd before the fit; and renew'd, if there be occaſion; and kept on till they grow dry and troubleſome.

An amulet againſt agues, eſpecially tertian.

19. Cut a handful of groundſel ſmall, put it into a ſquare paper-bag, about four inches every way; pricking that ſide which is to be next the ſkin, full of large holes; and cover it with ſome fine linen, that nothing may fall out. Let the patient wear this upon the pit of his ſtomach; renewing it two hours before every fit.

An often try'd remedy for an ague.

20. Boil yarrow in new milk, till it be tender enough for a cataplaſm. Apply this to the patient's wriſts, juſt when the cold fit is coming; and let it lie on till the fit is gone; and if another fit comes, uſe freſh cataplaſms as before.

For an ague.

21. Take the bone, called *Patella*, of the knee of a dead man; and having reduced it to fine powder, give of it as much as will lie upon a ſix-pence, for one doſe, in any proper conſerve, or vehicle, before the cold fit.

For agues.

22. Take ſalt of carduus, and ſalt of wormwood, each fifteen grains, tartar of vitriol half a ſcruple; mix them, and give them in a few ſpoonsfull of *Rheniſh* wine, or of ſome other convenient vehicle, either before the fit, or at ſome other time when the ſtomach is empty.

For taking off the fits of agues.

23. Give of good common brimſtone, reduced to a ſubtile powder, one dram and a half, or two drams, either made up into a bolus with a little honey, or in any appropriated vehicle; let it be given at the uſual times, and repeated once or twice, if need be, eſpecially if the fits ſhould return.

A medicine almoſt ſpecific for agues.

24. Take roſin of ſcammony twelve grains, diaphoretic antimony, and cryſtals of tartar, of each eight grains; mix theſe carefully, and give them for one doſe, an hour before the fit comes.

For an ague.

25. Take the ſoot of a baker's chimney, muſtard, rue, white-wine vinegar, ſallad-oil, ſome white pepper and ginger; make a poultis of them, and lay it to the pulſe of the arms, and let it lie on for a fortnight or three weeks.

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE.

For a dry or convulsive asthma.

34. Take choice saffron, reduced to a kind of powder; and with any convenient mixture, give eight or ten grains of it, in the form of pills, at bed-time.

For asthmatic coughs.

35. Take two ounces of oil of sweet almonds, fresh drawn, and put it upon one dram of flowers of brimstone; keep them, for a fortnight, in digestion, in a moderate heat, and then decant off the oil, or pass it through a clean linen rag, to keep back the brimstone: and of this liquor give a spoonful or two at a time.

A medicine for dry or convulsive asthma's, and for costiveness.

36. Give at bed-time, eight or ten grains of choice saffron, grossly pulverized, in a little syrup or conserve of violets.

For most asthmatic distempers.

37. Take of the roots of alecampane, thinly sliced, one ounce; of the leaves of ground-ivy a handful. Boil these in three pints of spring-water to a quart; strain the decoction, sweeten it with a little live honey, and let the patient take thereof six or seven spoonsfull at a time.

For most asthmatic distempers.

38. Take juice of hyssop, and choice honey, of each two pound; mix, boil, scum, and make a syrup; of which give four spoonsfull, or more, morning, noon, and night.

For the bloody-flux.

Bloody-flux. 39. Dry pigs-dung, and burn it to grey ashes; of which give about half a dram for a dose; drinking three spoonsfull of wine-vinegar after it.

For the bloody-flux and pleurisie.

40. Grate to fine powder the dry'd pizzle of a stag; and give of it as much as will lie upon a shilling, once or twice a day, in any convenient vehicle.

An experienced medicine for a dysentery, or bloody-flux.

41. Give about three ounces of the juice of ground-ivy, mixt with one ounce of the juice of plantain, once or twice a day.

To stop a dysentery, or bloody-flux.

42. Make up the powder of fuss-balls, with some conserve of roses, or other convenient substance, into pills; and of this mixture give as much in the dysentery, as contains from about a scruple, to half a dram of the powder.

For

For dyſenterical fluxes.

43. Take good *Venice*-turpentine, and, with a very gentle heat, evaporate it ſo far, that, when cold, it may almoſt coagulate. Incorporate this ſubſtance with fine ſugar, enough to make it up into pills, whereof give, in the morning faſting, as many as will amount from a ſcruple to a dram of the turpentine.

An experienced remedy for dyſenterical fluxes.

44. Take the thigh-bone of a man, calcine it to whiteneſs; and having purg'd the patient with an antimonial medicine, give him one dram of this powder for a doſe, in ſome good cordial.

For the dyſentery, and fluxes cauſed by ſharp humours.

45. Take from half a ſcruple to one ſcruple of *Mercurius dulcis*, and as much fine ſugar; and with ſome purgative, let the patient take it once a day; with care that none of it remain in his mouth or throat.

An often try'd medicine for fluxes of the belly, tho' bloody.

46. Give for a doſe, in any convenient vehicle, as much powder'd pizzle of a ſtag, as will lie upon an ordinary half-crown piece.

An effectual medicine for dyſenterical and other fluxes.

47. Take of the ſkin, liver, gall, and all the parts, except the muſcles, of a hare; and having dry'd them ſo, that they may be conveniently reduced to powder, give of it from about two ſcruples to one dram; in any convenient vehicle.

For a bloody-flux.

48. Take half an ounce of *London*-treacle, and an ounce of conſerve of red roſes; mix them together with ſome ſyrup of clove july-flowers, or of citrons, and keep them thus mix'd in a cover'd pot. Take of the electuary about the quantity of a walnut, night and morning, for two days, faſting two hours before and after; then intermit a day, and take it again in the like manner.

An often try'd remedy for the dyſentery, and ſharp fluxes of the belly.

49. Give from 15 to 20 grains of *Mercurius dulcis*, well prepar'd, and incorporated with about an ounce of catholicon, or one ſcruple of torrified rhubarb.

For the bloody-flux, or other fluxes.

50. Take of *Japan* earth, and powder of rhubarb, each equal parts; and give half a dram at a time, every morning, faſting.

MEDICINE.

An often try'd medicine for the bloody-flux, good alſo in pleuriſies.

51. Give one dram of the ſeed of flix-weed, in two or three ſpoonfull of any convenient vehicle, once or twice a day.

An approved medicine for the bloody-flux, good alſo for pleuriſies.

52. Give two or three ſcruples of hare's blood, beaten to powder, for one doſe, in a ſpoonfull or two of mint-water.

A very often experienced remedy, for dyſenteric and other fluxes.

53. Boil the quantity of a walnut of the freſh warm dung of a hog, and as much fine mutton-ſuet, ſliced thin, in a porringer of new-milk: when theſe are well incorporated, ſtrain them through a clean linen cloth; ſweeten it with loaf-ſugar, and let the patient take the medicine warm, once or twice a day.

To purifie and ſweeten the blood.

Blood to purify. 54. Take the *Minera* of *Hungarian*, or other choice antimony, and having ground it to very fine powder, without ſuffering it to touch any metal, give of it from ten grains to a dram, once a day, at dinner, that it may mix with the aliment.

To cleanſe the blood, and ſtrengthen weak patients.

55. Take of vipers, reduc'd to fine powder, one ounce, diaphoretic antimony half an ounce, clear yellow amber two drams, ſtarch as much as all the reſt, and of ſugar as much as of ſtarch; make them into a fine paſte with ſpirit of wine, and then form them into ſmall cakes, whereof one may ſerve for a doſe.

To reſolve extravaſated blood.

Blood to reſolve, when extravaſated. 56. Spread the powder'd root of burdoc, upon a linen cloth, and bind it quite round the part affected; renewing it twice a day.

To ſtrengthen the bowels.

Bowels to ſtrengthen. 57. Let the patient, from time to time, ſwallow a clove of garlic or two, without chewing.

To reduce flaggy breaſts to a good ſhape and plumpneſs.

Breaſts, their diſorders to cure. 58. Take green hemloc well bruis'd, and reduced to a kind of cataplaſm, to be apply'd, gently warm'd, to the parts, and kept on till it hath performed what was intended; ſhifting it once a day.

For ulcers in the breaſt, or elſewhere.

59. Take millepedes, or wood-lice, and having waſh'd them clean, with a little white-wine, and dry'd them with a linen cloth, beat them very

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MEDICINE. ſome thin pieces of linen or flanel therewith, and applying them luke-warm; and, likewiſe, you may, with a rag dipt therein, apply it to the eye-lids; taking care that none of it get into the eye itſelf, ſince there it would cauſe great ſmart. It may, alſo, be very uſefully ap-ply'd to burns; and yet more ſo to bruiſes.

For burns.

Burns. 66. Take gooſe-greaſe, and having ſoftly melted, and a little ſkimm'd it, ſqueeze into it as much freſhly expreſt juice of ground-ivy-leaves, as, by continual ſtirring, will bring it to the conſiſtence of a green oint-ment. With this anoint the part affected, and afterwards lay on it fine old rags, well dipt in the ſame ointment.

For burns, and ſtanching of blood.

67. Diſſolve a large proportion of ſugar in rain-water; and with a ſufficient quantity of linſeed-oil, or oil of olives, beat up this liquor till the oil be brought to the conſiſtence of an unguent, with which anoint the part affected as ſoon as poſſible; renewing the application occaſionally.

A very often experienced remedy for burns.

68. Take two parts of oil of walnuts, and one of honey, mix them well together over a gentle fire, and when they are thoroughly incor-porated, dip a feather in the mixture, and therewith anoint the part affected, ſo that the ointment may touch it immediately; and then ſtrew on it ſome powder of ceterach, or ſpleen-wort; keeping the part quiet, and defended from the air.

Againſt burns.

69. Beat onions into a ſoft maſs, and apply them, as ſpeedily as poſ-ſible, to the part affected; and keep them on it till they begin to grow dryiſh; and then, if need be, and apply freſh.

For a freſh burn.

70. Beat a ſufficient quantity of onions, very well, with common ſalt finely powder'd, to be applied, as a cataplaſm, warm, to the part affected; renewing it, if need be, till the impreſſion of the fire be taken out.

An excellent ointment for burns and ſcalds.

71. Take of the inner rind of the elder-tree, and of freſh ſheep's-dung, without any adhering ſtraws or foulneſs, of each one handful; and with freſh butter, or oil, make thereof an ointment, to be applied as uſual in ſuch caſes.

An approved remedy for burns, eſpecially recent ones.

72. Take a ſufficient quantity of adders-tongue, and gently boil it in linſeed-oil, till the liquor be ſtrongly impregnated with the herb; then ſtrain it, and keep it ſtopt for uſe.

An excellent ointment for burns and ſcalds.

73. Take of *Saccharum Saturni* half a dram, of the ſharpeſt vinegar four ounces; make a ſolution of the former in the latter, and add, drop by drop, (often ſtirring, or ſhaking them together) as much oil of elder as will ſerve to reduce the mixture into the form of a liniment.

For a burn.

74. Mix lime-water with linſeed-oil, by beating them together with a ſpoon; and, with a feather, dreſs the burn ſeveral times a day.

For a burn or ſcald in the eye.

75. Take the mucilages of quince-ſeed, flea-wort, linſeed and fenu-greek-ſeed, of each one ſcruple; boil them very lightly in 4 ounces of betony-water; filter and apply it to the part.

An approved medicine for a cancer, not broken.

76. Take dulcify'd colcothar, and with cream, or the whites of eggs, beaten to a water, bring it to a cataplaſm; which ought to be made large, and ſpread about the thickneſs of half a crown, and applied warm to the part affected; ſhifting it, at leaſt, once a day. *Cancers.*

For a cancer in the breaſt.

77. Take of the warts that grow on the hinder legs of a ſtone-horſe, dry them gently till you can reduce them to a powder, of which you may give half a dram for a doſe in any convenient vehicle. And to reſolve hard tumours in womens breaſts, apply to the part turnips boiled, and made unctuous with freſh hogs-lard.

A very often experienced medicine for cankers in the mouth, and elſewhere.

71. Take flowers of ſulphur one ounce, roach-alum, crude and finely pulveriz'd, half an ounce; mix theſe very well together, and incorporate them with as much good honey, as will ſerve to bring the mixture *Cankers.*

to

MEDICINE: to the consistence of a liniment, to be apply'd, from time to time, to the part affected.

A try'd medicine for chilblains.

Chilblains. 79. Take thick fresh parings of turnips, and hold them to the fire till they be very crisp; then apply them to the unbroken tumours or blisters, as hot as the patient can endure; keep them on for a competent time, and apply new if need require. They will cause the peccant matter to transpire, or otherwise waste, without breaking the blisters.

A remedy for chilblains.

80. take a turnip, roast it well under the embers, beat it to a poultis, apply it very hot to the part affected, and keep it on for three or four days; or shift it twice or thrice, if occasion require.

For the chin-cough, and stuffing of the lungs.

Colds and coughs. 81. Make syrup of peny-royal, or of ground-ivy, moderately tart with oil of vitriol; and of this let the patient take, very leisurely, about a quarter of a spoonfull from time to time.

For coughs, especially such as proceed from thin rheums.

82. Take of choice olibanum finely powder'd, from one scruple to half a dram, and mix with it an equal weight of sugar-candy; let the patient take it at bed-time, in the pap of an apple, for several nights together: it may, also, be taken occasionally, at any other time when the stomach is empty.

An approved remedy for a cold, and especially if it affects the breast.

83. Take a sheet of brown paper, of an even texture, and anoint it uniformly over, and very well, with old tallow, so that the paper may be thoroughly penetrated by it: then cover it thinly with nutmeg, and clap it warm to the pit of the stomach, that it may reach far both above and beneath it.

An experienced medicine for coughs.

84. Boil good turnips in water, and having express'd the juice, mix it with as much finely powder'd sugar-candy, as will bring it into a kind of syrup; of which let the patient swallow a little, as gently as he can, from time to time.

A medicine, which cured a gentlewoman, who had, in vain, taken much physic for a consumptive cough.

85. From ten or twelve fine raisins of the sun, take out the little kernels, and stuff the raisins with the tops of rue; and let the patient swal-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE. reduce the dry maſs to fine powder: and of this powder let the patient take at a time, as much as will lie upon a ſix-pence, in a proper vehicle.

For the colic and ſeveral other diſtempers.

92. Take 4 or 5 balls of freſh ſtone-horſe dung, and let them ſteep, for about a quarter of an hour, in a pint of white-wine, in a veſſel well ſtopp'd, that the liquor may be richly impregnated with the more volatile and ſubtile parts of the dung; ſtrain, and give of it from a quarter to half a pint, or more at a time; the patient having a care not to take cold after it.

An approved medicine for the colic.

93. Mix about half a dram of maſtic, with the yolk of a new-laid egg; and give it to the patient once or twice a day.

An experienced medicine for the colic.

94. Take of good nitre one ounce, rub it well in a clean ſtone-mortar, with half a ſcruple, or more, of fine ſaffron; and of this mixture give about half a dram for a doſe, in three or four ounces of cold ſpring-water.

A mixture for fits of the colic, and ſome kinds of convulſions.

95. Take one ounce of flower of ſulphur, and as much ſugar-candy; grind them very well together in a ſtone-mortar, and upon this quantity drop thirty drops of oil of carraway-ſeeds, as much of oranges, and as much of the oil of aniſeeds: incorporate theſe well, and of the mixture give about twenty or thirty grains for a doſe.

An incomparable medicine for the colic.

96. The yellow peel of oranges being reduced to powder, give from half a dram to two ſcruples of it, in any convenient vehicle.

An often experienced medicine for the colic, eſpecially if produced by ſharp humours.

97. To a quart of claret, put about two ounces of nettle-ſeeds; ſtop the bottle, and keep it in boiling water, a little, to aſſiſt the wine's impregnation with the finer part of the ſeeds; and of this liquor let the patient take a ſmall draught once or twice a day.

A good purging drink for the colic.

98. Take two ounces of rhubarb, four ounces of gentian, and a quart of good aniſeed-water; let the roots infuſe long in it, and give the patient about two ſpoonsfull at a time, as often as need requires.

An

A medicine almoſt ſpecific for a fit of the colic.

99. Take about half a dram of the expreſs'd oil of nutmegs, commonly called oil of mace; diſſolve it in ſome ſpoonsfull of good wine, which the patient is to take as hot as conveniently he can.

A try'd remedy for colics, good alſo in fits of the mother.

100. Take dry ginger, and cut it into thin ſlices; with theſe fill a pipe, and receive the ſmoke, as you would that of tobacco. Do this twice, thrice, or four times a day, but eſpecially at bed-time, and in the morning.

An excellent medicine for convulſive colics.

101. Take of the volatile ſalt of pigeons-dung two or three grains, or more; mix it with a ſcruple, or half a dram of the ſame dung crude, but ſlowly dry'd, and finely powder'd. Give this mixture for one doſe, in ſome ſpoonsfull of any convenient vehicle.

For the colic, or pains in the ſides.

102. Take two balls of freſh horſe-dung, and infuſe them for twelve hours in good white-wine, in a cloſe veſſel; then ſtrain the liquor, and let the patient take five or ſix ounces of it at a time.

For the colic.

103. Boil about one ounce of the ſeeds of black ſtinging nettles, in a quart, or more, of good claret-wine; ſtrain the decoction, and give of it a wine-glaſs full at a time, twice or thrice a day.

An excellent medicine for the colic.

104. Take of Dr. *Stephens*-water, plague-water, juniper-berry-water, of each half a pint, powder of rhubarb two ounces; mix theſe together, ſhake the bottle, and take about 4 ſpoonsfull at a time.

For the colic.

105. Give of orange-peel dry'd and powder'd, a ſpoonfull at a time, mixed with a little white ſugar, in any convenient vehicle.

A good medicine in pains of the colic or ſtone.

106. Take half a pint of ſallad-oil, and as much ſack, or claret-wine; ſhake them very well together, and give them, moderately warm, for a glyſter.

MEDICINE.

An approved medicine for inveterate ſcorbutic colics, and pains of the bowels.

107. Take *Engliſh* barley, well waſh'd, and boil it in a ſufficient quantity of freſh ſpring-water till it be ready to burſt; then pour off the clear, upon the yellow part of the rinds of lemmons, freſh cut from the white, and put them into a bottle, carefully ſtopt, for conſtant drink.

To make lime-water uſeful in ſeveral diſtempers.

Conſumptions. 108. Take one pound of good quick-lime, ſlake it in a gallon of warm water, and let it ſtand till all that will ſubſide be ſettled at the bottom, and after ſeparation, the water ſwim clear at the top; at which time, a kind of thin, brittle ſubſtance, like ice, will cover the ſurface of the liquor: as ſoon as the water is thus ſufficiently impregnated, pour it off warily, and keep it well ſtopped for uſe.

A lime-water for conſumptions and obſtructions.

109. In a gallon of cold lime-water, infuſe ſaſſafras, liquorice, and aniſeeds, of each 4 ounces, choice currants, or ſliced raiſins of the ſun, half a pound. The doſe is 4 or 5 ounces, to be taken twice a day.

A very nouriſhing aliment, that hath recovered many in conſumptions.

110. Boil eight or ten craw-fiſhes, after the blackeſt gut or ſtring is taken out, in barley-water, till they become very red; then take them out, and beat them long, ſhells and all, in a marble-mortar, and in a preſs ſtrongly ſqueeze out the juice; which may be given either alone, or mixt with about an equal part of chicken-broth, or ſome ſuch convenient alimental liquor.

For convulſions, eſpecially in children.

Convulſions. 111. Take earth-worms, waſh them well in white-wine, but ſo as they may not die in it; then dry the worms, with a moderate heat, upon hollow tiles, that they may be conveniently reduced to powder; to one ounce of which add ſome grains of amber-greece. The doſe is, from one dram to a dram and half, in any convenient vehicle.

For convulſions in children.

112. Give the patient from 2, 3, or 4, to 5, 6, or 7 grains, according to the child's age, of the true volatile ſalt of amber, in any proper vehicle. But this medicine is not ſo efficacious in full grown perſons.

A remedy that has cured many children of convulſive fits.

113. Put two or three drops of chymical oil of roſemary, into half an ounce of ſack; ſtop the vial, and let it be well ſhaken, to make a whitiſh mixture of the liquors, juſt before you give it. Or elſe in a half-

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MEDICINE.

A powerful remedy for corns.

120. Evaporate the ſtrongly expreſs'd juice of radiſhes, to the conſiſtence of a ſoft plaiſter, to be applied to the part affected, and ſhifted as often as it grows dry. 'Twill ſmart for a while, at firſt, but afterwards 'twill do its work.

A good remedy for corns of the feet.

121. Spread the yeaſt of beer upon a linen rag, and apply it to the part affected, renewing it once a day.

A try'd medicine to take away corns.

122. The part being made ſoft by bathing, and ſcrap'd, apply to the corn a plaiſter of ſhoemaker's wax; but if the part be very tender, your plaiſter may conſiſt of equal parts of ſhoemaker's wax, and diapalma, melted together, and ſpread thin.

An often try'd remedy for corns.

123. Mix up the juice of houſleek, with about equal parts of the thick yeaſt that ſticks to beer-barrels, or to the clay that ſtops them. Of theſe make a kind of plaiſter, which being kept upon the toe for a while, and renewed, will make the corn very ſoft, and eaſie to be extirpated.

A try'd remedy for corns.

124. Take ſtrained ammoniacum, and diapalma, of each an ounce; *Arcanum coralinum*, half an ounce, white precipitate two drams: mix them well together, and apply the plaiſter only over the corn, firſt cut as cloſe as is convenient.

An uſeful medicine for coſtiveneſs.

Coſtiveneſs. 125. Take virgin-honey a ſufficient quantity, and mix exactly with it as much finely powder'd *Cremor tartari*, as will bring it to the conſiſtence of a ſoft electuary; of which the patient may take, upon the point of a knife, the bigneſs of an almond.

An eaſy medicine for coſtiveneſs.

126. Take *Straſburg*-turpentine an ounce, and the yolk of an egg; grind them well together, and put thereto a pint of fat mutton-broth, and exhibit it, blood-warm, for a glyſter.

An innocent medicine for coſtiveneſs.

127. Boil in as much broth as will fill a large porringer, about half a handful of the leaves of common mallows, chopp'd; and of this broth ſtrained, let the patient make the firſt part of his meal.

For

For the cramp.

128. Chop the leaves of roſemary very ſmall, and ſew them ſo in fine linen or ſarſenet, as to make a kind of garter of them, to be ty'd about the patient's bare leg. *Cramp.*

To take off the pain of the cramp.

129. Take of the ointment of populeon two parts, oil of ſpike one part; mix them, and with the mixture chafe the part affected.

An amulet againſt the cramp.

130. With the root of mechoacan, in powder, fill a little bag of ſarſenet, about three inches ſquare; and hang it, by a ſtring, about the patient's neck, ſo that it may reach to the pit of the ſtomach, and touch the ſkin.

For incontinency of urine, or a beginning diabetes.

131. Having cut off the necks of blown ſheep's-bladders, put the remaining membranes, one over another, into a pot, where being cover'd and dry'd gently in a baker's oven, take them out, pulverize them well, and give as much as will lie upon a ſix-pence for a doſe. *Diabetes.*

An uſeful powder for ſuch as cannot hold their urine.

132. Take roots of the male piony, yellow amber, red coral, and gum arabic, of each a ſufficient quantity: reduce them to fine powder, mix them well, and let the patient take of this mixture from ten to twenty grains, twice a day.

A good medicine for the dropſy.

133. An ounce and half of ſliced mechoacan, being infuſed, for 24 hours, in a pint of white-wine, and the liquor drank of every morning for ſome days, is admirable in the dropſy; and if a little muſtard-ſeed be infuſed therein, it will be ſo much the better. *Dropſy.*

The Pilulæ Lunares; *excellent in the dropſy.*

134. Diſſolve any quantity of the beſt thoroughly refined ſilver, in ſpirit of nitre, or *Aqua fortis*, firſt cleanſed by ſilver; then evaporating away the ſuperfluous moiſture, let the reſt ſhoot into thin cryſtals; which being kept in a proper degree of heat, in a ſand-furnace, the greateſt part of the more looſe and fetid ſpirits of the menſtruum, will be driven away; yet the remaining cryſtals not be brought to flow. Let theſe cryſtals be counterpoized with their weight of cryſtals of nitre, and diſſolving each of them apart, in diſtilled rain-water, afterwards mix the ſolutions, and abſtract the ſuperfluous moiſture, till the remaining

MEDICINE. ing mass be dry; which you must keep exposed to such a temperate heat of sand, that the matter may not melt; yet the adhering corrosive spirits of the menstruum be driven away. To this end the mass must be stirred, from time to time, till the remaining white powder yields no offensive scent of the spirit of nitre, or *Aqua fortis*. Then, lastly, with the crumb of white-bread, made into a stiff paste, form the powder into a mass for pills, and preserve it in a well-stopp'd glass for use. The dose is somewhat uncertain. 'Tis, therefore, advisable, to make the pills of the size of very small pease; of which, one, given at bed-time, is sufficient in some constitutions, tho' others require two; and there are those who may take three. They ought to be gilt, or otherwise guarded from the tongue and palate, because of their extreamly strong and nauseous bitterness. Where there are serous humours, one dose of this pill will sometimes work for three or four days successively, yet moderately, and without much weakening the patient. If a continued use of them brings the patient to a leucophlegmatia, 'tis easily remedied by intermitting them for a while, and giving a little *Crocus Martis*, extract of juniper, or other astringents, to strengthen the *Viscera*, and preserve their tone.

An often try'd medicine for an erysipelas.

Erysipelas. 135. In the blood of a hunted hare, whilst 'tis yet warm, drench clean linen rags; dry them in the free air, and keep them dry: lay a large piece of linen, thus stained, upon the part affected, and either by binding, or otherwise, keep it from falling off, and renew it from day to day, if there be need. If it grow too stiff by long keeping, you may soften it with a little warm water.

An often tried external medicine for an erysipelas.

136. Take the blood of a hare, and if you can have it fresh, anoint the part affected with it; otherwise apply on it a linen rag, that has throughly imbibed the fresh blood of that animal, and been dried in the air.

An experienced medicine for an erysipelas.

137. The blood of almost any living creature, is found, by many experiments, to be a specific against an erysipelas, being often rubbed on the affected part; or a cloth dipt in the same being laid moist thereon.

For a slight excoriation.

Excoriations. 138. Melt mutton-suet, taken from about the kidneys, and freed from its superfluous fibres, or strings; and to about two ounces of this, add,

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE. drams of *Crocus metallorum*, exquiſitely ground; then very carefully filter the infuſion; of which let fall into the eye a drop or two, morning and evening; having a care not to ſhake the glaſs when you employ the liquor, leſt ſome unheeded duſt may have eſcaped the filter.

For a ſlight ophthalmia, or blood-ſhot eye.

146. Shake half a dram of prepared tutty into an ounce of red-roſe-water, and drop of it often into the eye.

For an ophthalmia, or blood-ſhot eye.

147. Take of the juice of houſleek two parts, that of daiſies and ground-ivy, of each one part; mix theſe juices together, and to about two ſpoonsfull of the mixture, put five or ſix drops of clarified honey: let the juices depurate themſelves by reſidence; and then, in ſome ſmall ſilver veſſel, clarifie them; and of this mixture let fall a drop or two into the eye, three or four times a day.

An experienced eye-water, for an inflammation and tumour of the eye.

148. Take of prepared tutty half an ounce, the water of white roſes, and of frogs-ſpawn, and alſo of the beſt canary wine, of each two ounces, of *Aqua mirabilis* half an ounce: mix theſe well, and drop a very little at a time into the patient's eye.

An experienced water for ſharp and ſlimy humours in the eyes and eye-lids.

149. Take of prepared tutty half an ounce, prepared coral and pearl of each half a ſcruple, *Trochiſci albi Rhaſis* five or ſix grains, red roſe-water, and ſuccory-water, of each an ounce and half; mix them well: and if you will have the medicine ſtronger, you may add three or four grains of aloes to it.

For a light ſtroke, or bruiſe on the eye.

150. Take two ounces of betony-water, and three drops of clarified honey; mix them well together, and drop them into the eye, three or four times a day. The compoſition muſt me made freſh every ſecond or third day.

A powerful medicine for things growing on the eye.

151. Take white paper, and let it flame away upon a clean pewter plate, till there remain ſo much oil behind, as you think you ſhall need; blow off the aſhes of the paper, and a little ſpittle being mixt, by the finger, with the oil, make a kind of ointment; which being taken up with a feather, is to be apply'd once or twice a day, as the patient can bear the ſmart, to the affected eye: and this courſe is to be continued, till the cure be compleated.

For

For hurts that make a ſolution of continuity in the eye.

152. To two ounces of celandine-water, put three or four drops of good clarified honey; and with this dreſs the eye at leaſt twice a day. But the mixture muſt be made freſh once in two or three days, or elſe it will grow ſouriſh.

An often try'd eye-water, eſpecially for outward diſorders of the eye.

153. Take of plantain-leaves four ounces, of ſtrawberry-leaves as much; bruiſe and digeſt theſe for 24 hours in a pint of good white-wine: then diſtil them to dryneſs in a glaſs-head and body, *in Balneo Mariæ*. The liquor that is thus obtained, put into a very clean braſs veſſel, and let it ſtand there for ſome hours, till it have acquired a manifeſt blue tincture; then put to it an equal weight of white roſe-water: ſhake theſe together, and let fall one drop into the internal corner of the eye; the patient bending backward, and ſhutting his eye-lids for a minute or two, that the water may diſperſe on the eye.

An uſeful medicine for pain or itching in the eye-lids, or in the eyes.

154. Boil half a ſpoonful of cleanſed *French*-barley, for a little while, in a pint of ſpring-water, ſeaſonably putting to it a pugil of dry'd damaſk roſe-leaves. Foment the part, for a pretty while, with a ſoft ſpunge dipt in this liquor, morning and night; having a care that it be applied warm, at leaſt.

An excellent eye-water for redneſs and light films in the eye.

155. Make ſome lime-water, by pouring a gallon of ſcalding hot water upon a pound, or ſomewhat more, of quick-lime; ſtir them together, and after ſome hours, decant that which is clear. To a pound of this water, put half an ounce of choice verdigreaſe pulverized; and, in a very moderate heat, extract a tincture of a fine, light ſapphirine colour. Decant this very warily, and let a drop or two of it, at a time, fall into the eye, as often as need requires.

To ſtop a violent defluxion on the eye.

156. Take red-ſage and rue, of each one handful, a ſpoonful of fine wheat-flower, and the white of a new-laid egg, beaten to water; mix theſe well, and ſpread them upon very thin leather, or black-ſilk, and apply it to the temples.

For red eyes, from a defluxion of a hot or ſharp humour.

157. Take the tops of roſemary one dram, and beat them up with one or two ounces of rotten pearmains, or pippins: and when, by ex-

MEDICINE. quiſite beating, you have reduced theſe to a cataplaſm, apply it warm to the part affected, binding it thereon, and letting it lie all night.

An eye-water.

158. Beat houſe-ſnails in their ſhells, and add to them about an equal quantity of juice of celandine; draw off the water in a cold ſtill, and keep what will come over, cloſe ſtopp'd for uſe.

The lady Fitz-Harding's *eye-water, which cured a perſon almoſt blind, whoſe eyes looked like glaſs.*

159. Take of white roſe-water, and eye-bright-water, of each three ſpoonsfull; as much ſifted white ſugar-candy as will lie on a three-pence, and the ſame quantity of fine aloes ſifted; ſhake all together, and let fall a few drops into the eye, every night, going to bed.

A wriſt-plaiſter, that often cures flying clouds in the eyes, and ſometimes leſſer ſpecks.

160. Take of rue, camomile, and hemloc, each half a handful; of bay-ſalt two ſpoonsfull, and one or two ounces of leaven; incorporate theſe well together, and apply it to the patient's wriſts, to be kept on till it grow dry.

For hot defluxions on the eyes.

161. Take of prepared tutty half an ounce, white roſe-water, and frogs ſpawn-water, of each two ounces, *Aqua Mirabilis* half an ounce; mix theſe well together, and let fall two or three drops into the patient's eyes, eſpecially at bed-time.

An uſeful eye-water, to keep the eyes cool and moderately dry.

162. Take two ounces of ſuccory-water, half a dram of prepared tutty; ſhake them well, and keep them together for uſe.

An often try'd wriſt-plaiſter, for defluxions on the eyes.

163. Take rue, camomile, hemloc, and wormwood, of each half a handful, bay-ſalt pulveriz'd two ſpoonsfull, ſour dough an ounce; mix all theſe together, moiſtning them from time to time with elder-vinegar, to a proper conſiſtence; and apply it to the wriſt of that ſide on which the part is affected; renewing it if there be occaſion.

For a little tumour in the carneous tunicles of the eyes.

164. Dreſs the eye, from time to time, with the decoction of mucilages, to ripen the tumour; then open it with a lancet, and ſqueeze out all the matter; and, laſtly, cleanſe and heal the part with honey. But when the tumour is beginning, you may, in want of the decoction of

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A medicine for hurts in the eye.

171. Take ſuccory-water, and crumbs of white-bread, enough to bring it to a due conſiſtence; then add a little ſaffron; ſometimes, alſo, you may put to it a little honey, to make it more cleanſing and healing. Apply it with pledgets of flax, to the part affected.

A good water for eyes that are foul, and pained by ſharp humours.

172. Take prepared pearl, and coral, of each one ſcruple, aloes caballina, finely powder'd, three grains, red roſe-water, and ſuccory-water, of each one ounce; mix them well; and if you would have the mixture ſtronger, put in a few grains of *Trochiſci albi Rhaſis* in very fine powder.

An experienced medicine for ſtrengthening a weak ſight.

173. Take of eye-bright, ſweet fennel-ſeeds, and fine ſugar, all reduced to powder, of each an ounce, nutmeg, alſo pulveriz'd, one dram; mix theſe very well together, and take of the compoſition, from one dram, to two or more, from time to time.

To take off little pimples, or inequalities, within the eye-lids.

174. Take eye-bright-water, plantain-water, of each a ſpoonfull, and half a ſpoonfull of red roſe-water; mix theſe, and put to them about 15 grains of prepared tutty; ſhake them together, and let the powder fall to the bottom; and, with the clear liquor, moiſten the eye ſeveral times in a day.

To ſtrengthen a weak ſight.

175. Take eye-bright, peny-royal, rue, celandine, lovage, ſaxifrage, of each half a handful, blue-bottle flowers, fennel-ſeeds, parſley-ſeeds, of each half a dram, grains of paradiſe one dram, hyſſop, organy, willow-leaves, each half an ounce, galingal three drams, ginger half a dram, cinnamon one dram, ſugar half an ounce. Let them be finely powder'd, and very well mixt together. Take of this powder one ſcruple, or half a dram, every day with your dinner.

To ſtrengthen the ſight.

176. Take roſemary-flowers, ſage, betony, rue, and ſuccory, of each one handful; infuſe theſe in two quarts of good ſack, and diſtil them in a copper alembic. The doſe is a moderate ſpoonfull.

To ſtrengthen the ſight.

177. Take powder of eye-bright one ounce, ordinary fennel-ſeed, in powder, half an ounce, powder of nutmeg half a quarter of an ounce, double refined ſugar two ounces. All theſe, being finely powder'd,

are

are to be mixt together, and taken as much as will lie on a ſhilling at a time, as often as you pleaſe. The powder is to be kept in a box, cloſe ſhut, in ſome dry place. This has perform'd great cures in dimneſs of ſight, and rheums in the eyes. MEDICINE.

A medicine ſeveral times uſed, for a light ſtroke, or contuſion of the eye.

178. Put to two ounces of carduus-water, or that of betony, three or four drops of honey; uſe it every three hours. But keep it not above a day or two, leſt it grow ſour.

A drink, to be taken like tea, for ſtrengthening the ſight.

179. To a quart of water ready to boil, put half a handful of eye-bright; and let the liquor boil a very little before you take it off.

A water to ſtrengthen the ſight.

180. Diſtil clary in a cold ſtill; and of the water let the patient take every morning, and, if need be, every night, going to bed, from two or three ſpoonsfull to ſix, either alone, or ſweetned with a little ſugar; let him, alſo, with the ſame water, unſweeten'd, bathe or waſh the parts affected, in the morning, and at bed-time, or oftener.

An excellent water to preſerve the ſight.

181. To half an ounce of celandine-water, and two drams of ſuccory-water, put two or three drops of clarified honey, and ſhake them together when you uſe them. Of this water let fall a drop or two into the eye, once or twice a day. It will not keep above three or four days, eſpecially in ſummer, and, therefore, muſt be often renewed.

An often experienced medicine for blood-ſhot eyes.

182. Cut a new laid egg, boil'd hard, into halfs, and apply one of theſe, conſiderably warm, to the part affected, and keep it on for ſome hours. To the ſame purpoſe you may apply a poultis made of a rotten apple; the cold being firſt quite taken off.

A medicine for blood-ſhot, or inflamed eyes.

183. Bathe the eyes ſeveral times every day, with a waſh made of frogs-ſpawn-water a pint, and ſalt of tartar a dram.

An excellent remedy for an inflammation in the eyes.

184. From an apple, cut into halfs, take out all the core, fill up the cavities with the tender tops of common wormwood, tye the halves together, and roaſt the apple well: then beat it, with the herb, to a kind of poultis, apply it warm to the part affected, and bind it thereon; letting it lie all night, or, if you uſe it in the day-time, for 6 or 8 hours.

An

Medicinal Experiments.

An uſeful remedy for redneſs of the eyes.

185. Take a blanch'd almond, and three grains of camphire, and in a marble mortar, incorporate them by grinding; then add, little by little, two or three ounces of red roſe-water; ſtill grinding them till the whole be brought to a kind of emulſion. Drop a little of this into the part affected.

A medicine for redneſs of the eyes.

186. If the redneſs be attended with a fiery hot rheum, waſh the eyes, twice or thrice a day, with brandy.

For a ſlight inflammation of the eyes, or a hordeum *growing on the eye-lid.*

117. Take freſh houſleek; beat it to a kind of cataplaſm, and lay as much as is needful of it in the fold of a linen-rag, to be ſo apply'd, that the cataplaſm may reach the eye, and the reſt of the cloth be faſten'd about the patient's head. Let the medicine lie on all night, and be taken off the next morning. Repeat this application two or three times occaſionally.

For a ſlight redneſs of the eyes.

188. Take of *French* barley half an ounce, and of damaſk roſes half a handful; boil them, a very little, in a pint of ſpring-water; and with this moiſten the part affected.

For a ſlight redneſs of the eyes.

189. Take frog-ſpawn-water a pint, common ſpirit of wine 4 ounces; mix them: waſh the eyes therewith, five or ſix times a day; and at bed-time apply over them a cataplaſm of a rotten apple.

An uſeful medicine to prevent dryneſs, and ſome other diſorders of the eyes.

190. Take of choice virgin-honey two ſpoonsfull, of ſuccory-water, and the diſtilled water of eye-bright, each 4 ſpoonsfull; mix them, and in a very clean veſſel, over a very gentle fire, let them evaporate, taking the ſcum off from time to time, till the mixture comes to the conſiſtence of a ſyrup; keep this in a glaſs well ſtopp'd, and uſe it by letting fall a drop or two, at a time, into the eye.

A medicine to prevent running of the eyes.

191. In half a pint of white-wine, diſſolve two drams of white vitriol; filter it, and add choice honey two ounces: with this bathe the eyes two or three times a day.

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE.

An excellent fumigation for pains in the eyes, too great dryneſs of them, and when a beginning cataract is apprehended.

200. Take of fennel, hyſſop, betony, celandine, carduus, of each half a handful, linſeed, quince-ſeed, fenugreek, and fleawort-ſeed, of each half a dram, of *French* barley one ounce: boil theſe in two quarts of fair water, and half a pint of white-wine; and let the patient hold his head over the fumes of them, taken off the fire, for about a quarter of an hour every morning.

For ſore eyes.

201. Take the crumb of white-bread, half an ounce, coral, pearl and tutty prepar'd, and white ſugar-candy, of each half a dram; powder of red-roſes a dram and half, flowers of St. *John*'s-wort one dram; and with a ſufficient quantity of milk, make a cataplaſm, to be ſpread upon linen, and bound over the eye.

For heavineſs, and pain in the eyes.

202. Take flowers of melilot, elder, and of marigolds, of each a ſmall handful, linſeed, ſeeds of fenugreek, fleawort, cummin, and quinces, of each half a ſcruple, *French* barley half an ounce, damaſk roſes half an ounce, ſpring-water a pint and an half; mix and make a decoction, with which foment the forehead, temples, and eye-brows, warm.

For a dry inflammation in the eyes.

203. Take of betony, hyſſop, rue, wormwood, vervain, ſage-flowers, and roſemary-flowers, of each half a handful; the ſeeds of cummin, fennel, and carduus, of each a quarter of an ounce; boil theſe, a little, in two or three quarts of fair water, and let the patient hold his head, for about a quarter of an hour, over the ſteam of the decoction; uſing a napkin to keep the ſmoak from diſſipating, and to direct it to his eyes.

A famous eye-water.

204. Take two or three ounces of the water of pimpernel, diſtill'd *in balneo*, put this into a little porringer of roſe-copper; and add about the bigneſs of a filbert, of ſtrong quicklime: cover the veſſel, and let the ingredients lie in it till the liquor hath acquir'd a bluiſh colour. Then very warily pour off the clear, and add to it as much live honey, as will give it a little taſte: uſe it after the uſual manner of ſuch waters; and if it be too ſtrong, dilute it a little with water of the ſame plant, or good ſpring-water.

A famous eye-water.

150. Take red roſe-water a quart, aloes in fine powder, half an ounce, white vitriol, *Vitrum Antimonii*, *Crocus metallorum*, of each ſix drams; mix and digeſt, warm, for a month: then uſe the clear liquor three or four times a day: it has ſcarcely an equal.

An eye-water.

206. Take red roſe-water, plantain-water, of each an ounce; tutty prepared, half a ſcruple; *Lapis Lazuli* prepared, 6 grains; red coral prepared, 5 grains; mix, and make an eye-water. This dropped into the eyes, being firſt well ſhaken, cures inflammations of them, provided there be no great foulneſs, or ſcrophulous diſpoſition in the patient. It takes off the redneſs of the eye-lids, if with a ſponge dipt in it, they be often wetted: it alſo takes off films very well.

To clear the eyes from films.

207. Take human dung, of a good colour and conſiſtence, dry it ſlowly till it be pulverable; then reduce it into an inpalpable powder, which is to be blown once, twice, or trice a day, as occaſion ſhall require, into the patient's eyes.

To allay heat in the eyes, proceeding from ſharp humours.

208. Beat the white of an egg into a water, in which diſſolve a conſiderable quantity of refined loaf-ſugar; and then drop ſome of it into the patient's eyes.

For a ſlight ſtroke, or bruiſe on the eye.

209. Take two ſpoonsfull of fennel-water, or of betony-water, and let fall into it 4 or 5 drops at moſt, of good clarify'd honey: ſhake them well together, and uſe them twice or thrice a day. But you muſt have a care to make this mixture freſh once in 4 or 5 days, eſpecially in ſummer: for if it be much longer kept, 'twill grow ſour.

An excellent eye-water, to preſerve them from rheums, eſpecially ſharp ones.

110. From two parts of celandine, and one of eye-bright, diſtil *in balneo* a water, which put upon pulveriz'd *Lapis Calaminaris*, and let them digeſt together, in an exactly clos'd veſſel, for ſome weeks; adding, before you uſe it, a third part of brandy.

For the falling-ſickneſs in children.

211. Give half a dram of choice amber, finely powder'd, for ſix or ſeven weeks together, once a day, when the ſtomach is empty, in about 4 ounces of good white-wine. *For the falling ſickneſs.*

Medicinal Experiments.

Againſt the falling-ſickneſs.

212. Take of the powder of true miſſeltoe of the oak, as much as will lye upon a ſix-pence, early in the morning, in black-cherry-water, for ſome days, near the full-moon.

To appeaſe the heat of fevers by an external remedy.

Fevers. 213. Apply to the ſoles of the feet a mixture, or thin cataplaſm, made of *Virginia* tobacco, beaten up with as many freſh currants, as will bring it to a poultis.

An excellent drink in fevers, tho' malignant.

214. To a quart of boiling ſpring-water, put one ounce of hartſhorn calcin'd to perfect whiteneſs; and when the mixture is cold, add three ounces of ſyrup of the juice of lemmons: when you wou'd uſe it, ſhake it well, and let the patient take a moderate draught, ſeveral times in the day and night.

An uſeful drink in feveriſh diſtempers.

215. In a pint and half of clear poſſet-drink, boil about one ounce of the cleans'd roots of dandelion, ſliced ſmall, till near half a pint be waſted; then ſtrain it, and let the patient take half a pint, or the whole quantity, if he can, at a time.

A good drink in continual fevers.

216. Boil the leaves of rue in fair water, till the liquor taſte pretty ſtrong of the plant: this being ſtrained, is to be made palatable with liquorice, or a little ſugar; and to half a pint of it, add about ten drops of ſpirit of vitriol; and let the patient uſe it for ordinary drink.

A good drink to be frequently uſed in fevers, eſpecially continual ones.

217. Give in half a pint of ſome ſmall convenient drink, half an ounce of hartſhorn, burnt to a great whiteneſs, and a little boiled in the liquor; and this is to be taken from time to time.

Sir Walter Raleigh's *cordial; an approved and moſt excellent remedy for fevers, fluxes, or any caſe where diaphoretics, antidotes, and cordials are proper.*

218. Take the dry'd flowers of borage, roſemary, marigolds, red july-flowers, *Roſa ſolis*, and elder-flowers, of each two quarts, of dry'd ſcor-

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MEDICINE.

Furor uterinus.

To appeaſe the fits of a Furor Uterinus.

220. Burn the feathers of partridges, for a competent time, under the patient's noſe.

A try'd medicine for the falling down of the fundament.

Falling of the fundament.

221. Put ſome ſliced ginger in a little pan, heat it by clear and well-kindled coals, and let the patient receive the fume of it, caſt on by degrees, in a proper ſeat, where the lower part of the body may be well cover'd, for about half a quarter of an hour at a time.

For a ſlight gangrene.

Gangrenes.

122. After having lightly ſcarrified the part, apply, as hot as the patient can well bear it, a cataplaſm made of ſtrong brandy, and the crumb of white-bread; ſhifting it three or four times a day, or oftener, if need be.

To prevent a gangrene upon a great pain, and to ſtrengthen the part.

223. Take of melilot-plaiſter, and diapalma, equal parts; and having melted, and well incorporated them together, make thereof a thin plaiſter, which, being prickt full of holes, is to be laid upon the inflamed, or bruiſed part, firſt lightly ſcarrified.

An experienced medicine for a gonorrhœa.

Gonorrhœa.

224. Infuſe two ounces of ripe laurel-berries, for a day, in a quart of good white-wine; and of this let the patient drink about two or three ſpoonsfull, twice a day, for a pretty while together; omitting it once in three days, that he may take ſome gentle purging medicine.

For a gonorrhœa.

225. Swallow about half a dram of choice maſtic, in powder, put into the yolk of a new-laid egg; waſhing it down, if it be thought needful, with any convenient liquor.

For the gonorrhœa.

226. Take equal parts of choice amber, and of maſtic, both in fine powder, mix them, and of this mixture give half a dram at a time in a proper vehicle, or in a draught of chocolate: continue it for three weeks, or a month, if need require; purging the day before you begin to take it, and once every week afterwards, eſpecially when you leave off the uſe of the powder.

For

For a gonorrhœa.

227. Take equal parts of choice red coral, and of maſtic, reduce them ſeparately to fine powder; mix them very well, and give about 30 or 40 grains for one doſe.

An often experienced remedy to expel gravel, and provoke ſuppreſt urine.

228. Take the thick membrane that lines the gizzard of a cock or hen, and having wip'd it clean, dry it ſo, that it may be beaten to powder: with this mix an equal part of choice red coral calcin'd, and of the mixture give from 20 or 30, to 40 or 50 grains. *The gravel.*

An experienced remedy to expel gravel, and provoke urine.

229. Take the juice of onions two ſpoonsfull, white-wine half a pint; mix them for a draught. It gives preſent eaſe; and, if repeated for ſome time, ſoon cures.

To drive away gravel and ſmall ſtones.

230. Take the thick ſkin, found in the gizzard of a cock or hen, and having warily dry'd it, till it be pulverable; give from a ſcruple to two ſcruples of it, in a draught of any convenient vehicle.

To take off the pains of the gout.

231. Take red-lead, ground fine, half a pound, oil of earth-worms one pound; boil them to the conſiſtence of a hard plaiſter, without burning: afterwards add of camphire two ounces, diſſolved in oil of earth-worms, and make a plaiſter of a juſt conſiſtence. *The gout.*

An excellent ointment in the gout.

232. Take *Barbadoes*-tar, and palm-oyl, of each a like quantity, melt them gently together; and with the mixture warm, let the part be anointed, and warily chafed.

An effectual medicine for gouty pains.

233. Beat linſeed, with a little water, in a marble mortar; rubbing it very well, that the medullary part being ſeparated from the huſk, may make the water conſiderably white. In this liquor, clean rags being thoroughly wetted, apply them, ſomewhat warm, to the part affected, ſhifting them, if need be, once in an hour or two.

A ſpeedy remedy to take off gouty pains.

234 With a feather, dipt in good ſpirit of ſal-armoniac, moiſten gently, all the parts affected.

A medicine that ſoon appeaſes the pains of the gout.

235. Take of black ſoap 4 ounces, choice wood-ſoot, finely ſifted, a dram and half, and half the yolk of an egg; incorporate them together, and ſpreading the mixture ſomewhat thin, apply it warm, by way of cataplaſm, to the part affected.

An often try'd medicine to appeaſe the pains of ſcorbutic running gouts.

236. Having fill'd an earthen pot with cleans'd earth-worms, and luted on a cover, ſet it into an oven, with a batch of bread, and let it ſtand there till the oven be cold. Then take out the pot, and having remov'd the cover, you will find the matter turn'd into a groſs ill-ſcented liquor. Strain this by expreſſion, and keep it ſtopt, to rub therewith the part affected, with a warm hand, once or twice a day. If the ſmell be offenſive, you may put to it a few drops of oil of rhodium, *&c.* to correct it.

To take away gouty, or other arthritic pains.

237. Anoint the part with highly rectify'd ſpirit of human urine, the cold being juſt taken off, once or twice the firſt day, and no longer, unleſs the pain continue.

To check the fits of the gout, and, in ſome meaſure, to prevent them.

238. Take three ounces of ſarſaparilla ſliced thin; and an equal weight of raiſins of the ſun, rubb'd very clean, but not broken; put both into three quarts of ſpring-water, and let the containing veſſel ſtand in a moderate heat, that the liquor may ſimmer for ſeveral hours, yet without burſting the raiſins; keep this decoction well ſtopt, and let the patient uſe it for his only drink.

To appeaſe the pains of the gout, and leſſen the fits of it.

239. Take one part of ſpirit of ſal-armoniac, and three parts of ſpirit of wine, neither of them too well rectify'd: ſhake them together; and having dipt old, clean linen rags in the mixture, apply them to the part affected, ſhifting them now and then.

A poultis to appeaſe pains and aches, even ſuch as are arthritic, or gouty.

240. Boil or ſtew onions in water, till they be ſoft enough to make a poultis; then drain away the water, and beat them; and having ſpread them, to a conſiderable thickneſs, upon a linen-cloth, apply them as hot as the patient can well bear; and let them be kept on all night.

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE.

To evacuate the rheum that ſwells the gums, and cauſes the tooth-ach.

249. Diſſolve a ſpoonfull of good muſtard in a pint of *French* wine, and having warm'd it a little, let the patient, from time to time, waſh his mouth with it, and hold it therein for a pretty while together.

An approved medicine for ſcorbutic gums, and to faſten the teeth.

250. Take of white-wine a pint, of alum half an ounce, of juniper berries, and of red ſage, each one ounce; boil theſe together, till a quarter of the liquor be waſted; then put into the remaining part 4 ounces of honey, and let it boil till the ſcum be all riſen; filter it, and put into it one dram of *Balſamum vitæ*.

A medicine for ſcorbutic gums, and to faſten the teeth.

251. Take claret-wine a pint, roch-alum half an ounce; mix, diſſolve, and add ſix ounces of ſtrong tincture of *Japan* earth, made with common brandy.

To take out the marks of gunpowder, ſhot into the ſkin.

Gun-powder-marks. 252. Take freſh cow-dung, and having warm'd it a little, apply it as a poultis, to the part affected; renewing it from time to time, as occaſion ſhall require.

An excellent ſtyptic powder to ſtop hemorrhages.

Hemorrhages. 253. Take equal parts of white ſugur-candy, roch-alum burnt, and white vitriol, pulverize them exceeding well, and mix them diligently; and having dipt pledgets of lint, moiſtned with the white of an egg, into this powder, apply them to the orifices of the bleeding veſſels. And after the dry ingredients are mixt, you may grind them with as much whites of eggs, beaten to water, as will make a paſte, to be throughly dry'd in the air, and then again reduc'd to powder.

A powerful ſtyptic.

254. Make a fine powder of *Lapis Hæmatites*, by grinding it exactly well with an equal or double weight of ſal-armoniac; and of this high-coloured ſublimate, put a little upon the orifices of the bleeding veſſels.

A medicine for ſtanching of blood.

255. For ſtanching of blood, few medicines exceed the colcothar of vitriol, whether waſh'd, and freed from its ſalt, or unwaſh'd.

To

To ſtanch blood, eſpecially in wounds.

256. Take puff-balls, when they are full ripe, which is in autumn, and breaking them warily, ſave the powder that will fly up, and the reſt that remains in their cavities; and ſtrew this all over the part affected, binding it on; or proceeding further, if need be, according to art.

To ſtanch blood from the noſe.

257. Let the patient hold knot-graſs, and *Solomon*'s-ſeal, in his hand, till it grow warm there, or longer, if need be.

To ſtanch blood in any part of the body.

258. Take plantain-water two ounces, barley-cinnamon-water ſix drams, ſpirit of vinegar one ounce, dragons-blood half a dram, ſyrup of myrtles five drams; mix and make a julep, of which let the patient take three ſpoonsfull every hour.

A ſtyptic water, for ſtopping of blood in any part of the body.

259. Put one pound of excellent quick-lime into a clean earthen pot, pour upon it five or ſix pounds of fountain-water; cover the pot cloſe, and let it lie to infuſe for about an hour; then ſtir it with a ſtick for a little time, and let it lie, as before, for 24 hours, ſometimes ſtirring it; laſtly, let it ſettle; and the water being very clear above, pour it off by inclination without ſtirring: take of this water one pound, which being put into a vial, add to it a dram and half of ſublimate, finely powder'd; then ſhake all together, ſo that the powder may diſſolve, and be of an orange colour, and the liquor, in the end, clear and limpid; the red powder falling to the bottom. The water being clarified, you muſt pour it from the grounds into another veſſel; and add to it one dram of oil of vitriol, and an ounce of *Saccharum Saturni*. Shake all together, that they may mix the better; afterwards let all ſettle, and pour off the clear water for uſe.

An excellent ſtyptic for ſtopping of blood.

260. Take *Hungarian* vitriol, and alum, of each half a pound, phlegm of vitriol ten pounds; boil to a diſſolution of the vitriol and alum: being cold, filter it through brown paper; and if any cryſtals ſhoot, ſeparate the liquor from them, adding to each pound one ounce of oil of vitriol. Dip cloths into this liquor, and apply them to the part affected.

An often try'd ſtyptic to ſtanch blood, eſpecially in wounds.

261. Take colcothar, as it comes out of the retort, and having powder'd it, roll tents of lint in it, and apply them to the orifices of the

MEDICINE. greater veſſels; and fill the cavity of the wound, partly with colcothar too.

An effectual medicine to ſtop bleeding in wounds, and check ſome other hemorrhages.

262. Strew upon the part the fine powder of clear roſin.

A quick remedy for a ſmall freſh cut or wound.

263. Let the patient ſpeedily plunge the hurt part into brandy, and keep it there for a while, till the pain thereby excited ceaſe, or be much abated: or if the part be unfit for this operation, the liquor may be apply'd to it, immediately, with a ſpunge, *&c.*

For the head-ach.

Head-ach. 264. Take green hemloc that is tender, and put it in your ſocks, ſo that it may lie thin between them and the ſoles of your feet: ſhift the herb once a day.

An excellent medicine for fits of the head-ach.

265. Boil a handfull of freſh roſemary, for a pretty while, in a quart of common water; and let the patient cover his head and face with a napkin, ſo that he may receive the ſteam of the decoction for ſome time, as hot as he can well bear it.

An experienced ſternutatory to clear the head.

266. Let the patient ſnuff up, in the morning faſting, a ſmall ſpoonfull, or leſs, of the clarified juice of ground-ivy, or of beets; ſpitting out, from time to time, what liquor comes into his mouth.

An excellent cephalic, good alſo for the eyes.

267. Take the flowers of betony, marjoram, damaſk-roſes, ſage, and roſemary, all at diſcretion: to theſe add the powder of *Lignum aloes*, and ſome ſeeds of *Nigella Romana*. Reduce all to powder, to be uſed as a hair-powder, when the patient goes to bed.

An experienced medicine for dulneſs of hearing, and hyſterical diſorders.

Hearing diſorder'd. 268. The juice of red onions is excellent for diſeaſes of the ears, or for deafneſs, in the beginning. And betony roots wonderfully prevail againſt all diſorders of the womb.

An approved remedy for deafneſs.

269. Of the breaſt-milk of a woman, let fall three or four drops warm, as it comes from the nipple, into the part affected.

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Medicinal Experiments.

For the jaundice.

276. Take two or three ounces of hemp-ſeed, and boil them till ſome of them begin to burſt, and a little longer, in a ſufficient quantity of new milk, to make one good draught; which the patient is to take warm, repeating it, if need be, for ſome days together.

For the jaundice in children.

277. Take half an ounce of choice rhubarb in powder, incorporate with it exactly, by long beating, two handsfull of well cleanſed currants. Of this electuary let the patient take, every morning, about the quantity of a nutmeg, for ſeveral days together.

An experienced cure for the yellow-jaundice.

278. Take the gall-bladder of a ſheep, and near the top, without emptying the liquor, make a ſmall hole, at which put in two or three drops of the patient's urine; then tie up the upper part of the bladder, and hang it in the free air till it dry up.

An effectual medicine for the yellow-jaundice.

279. Give about half a dram of white hens-dung, dry'd, and mixt with a little ſugar, in a few ſpoonsfull of white-wine.

A medicine, almoſt ſpecific, for the yellow-jaundice.

280. With clean filings of ſteel mix ſome loaf-ſugar; grind them long with great exactneſs; for in that conſiſts the chief ſecret of this medicine. Of this impalpable powder, give about half a dram for a doſe, beſides the ſugar, twice or thrice a day, in any convenient vehicle.

A ſpecific for the yellow-jaundice.

281. Take one part of good ſaffron, gently dry'd and powder'd, and incorporate it well with four parts of choice turmeric. Take, alſo, a handful of freſh ſheep's-dung, and let it ſteep in about a quart of ſtrong ale, in a moderate heat, till the liquor be fully impregnated with the dung, then ſtrain it lightly through a linen cloth. In a large draught of it, give about half a dram of the forementioned powder. This do in the morning faſting, and in the evening about bed-time; giving alſo another doſe on the following morning.

For the yellow-jaundice.

282. Take rhubarb two drams, ſaffron, and mace, of each a dram, hemp-ſeed one handfull; bruiſe them, and put thereto a quart of white-wine, and ſet all in a gentle heat to extract: then take, mornings and evenings, on an empty ſtomach, about a quarter of a pint; and, when

when all is ſpent, pour more wine upon the ingredients, adding a little freſh rhubarb and ſaffron, and uſe it as before. MEDICINE.

A medicine, almoſt ſpecific, for the jaundice.

283. With ſmall ale, draw a deep green tincture from freſh ſheep's-dung; and in a little draught of this, give from half a dram to a dram of a powder'd mixture, conſiſting of 4 parts of turmetic, and one of *Engliſh* ſaffron. This doſe may be given twice, or thrice a day; the patient, whom it will diſpoſe to ſweat, keeping very warm, whilſt the operation laſts.

For the black jaundice.

284. Boil a ſpoonfull of honey, gently, and ſcum it, till it come to a good conſiſtence; then add of wheat-flower and ſaffron, reduced to a powder, as much of each, as will lie upon the point of a knife; and having mixed all well, put it over the coals again, till it loſe its ſmell; afterwards keep it in a little earthen pot, and let the patient, with the quantity of a pea, anoint the navel, and fill the cavity thereof with it; repeating the application for ſome days together, when the ſtomach is empty, and abſtaining from meat and drink for about two hours after the medicine is uſed.

To take off the pain and inflammation of ulcers in the legs, and elſewhere.

285. In a quart of water, boil about as much white-bread, as is uſually contained in a half-penny loaf; then add to it two ounces of good ſheep-ſuet cut ſmall; and when that is boil'd a little, add one ounce of powder'd roſin, and a little well-ſears'd brimſtone: of theſe make a cataplaſm, which is to be kept, conſtantly, on the part affected, and ſhifted once or twice a day, as need ſhall require. *Inflammation.*

To make an iſſue raw, that begins to heal.

286. Take of *Lapis infernalis* one ounce, of crown ſoap an ounce and an half, chalk finely powder'd ſix drams; mix them together carefully, and keep them cloſe ſtopt, except when you mean to uſe them. *Iſſues to make run.*

An internal medicine for the itch.

287. Boil four ounces of clean quick-ſilver, in a gallon and half of ſpring-water; and let the patient take of this between a quarter and half a pint at a time, after purging. *For the itch.*

An experienced waſh, that quickly cures the itch.

288. Take ſtrong quick-lime one pound, and put to it a gallon of ſpring-water; let them lie together for ſome hours, and then warily pour off the clear; filter the reſt, and take two ounces of quick-ſilver, tyed up in a linen bag; hang it in the liquor, and boil it for half an hour;

MEDICINE. hour; then pour off the clear liquor once more, and waſh only the hands with it, twice, or, at moſt, thrice a day.

An experienced liquor to cure the itch in the hands or face, without mercury or ſulphur.

289. Take a handfull of the roots of elecampane, and as much of ſharp-pointed dock; ſhred them ſmall, and boil them in two quarts of ſpring-water, to the conſumption of a pint. Then ſtrain the liquor, and with it let the patient waſh his hands, or other parts affected, once or twice a day.

To mitigate pains in the kidneys.

For diſorders in the kidneys. 290. Take oil of ſcorpions, and oil of bees-wax, of each a like quantity; mix them well, and with it moderately warm'd, anoint the pained kidney.

An effectual remedy for a ſtoppage in the kidneys.

291. Give, in any convenient liquor, about twelve grains of ſalt of amber for a doſe.

A medicine, almoſt ſpecific, for exulcerations in the kidneys.

292. Having reduced jet to fine powder, give of it about half a dram for a doſe, in white-wine, in the morning faſting, and at bed-time, for ſome days together.

The great medicine, of a famous empiric, for the king's-evil.

King's-evil. 293. Give, for a good while together, a pretty ſtrong decoction of devil's-bit.

An uſeful drink for the king's-evil, and ſome diſorders from the like cauſe.

294. Take a large handfull of the leaves of ground-ivy, waſh off the duſt with beer, and put the herb into a gallon of ale-wort; when 'tis ripe for drinking, draw it out into bottles, and let the patient take a draught of it twice or thrice a day, at meals.

An uſeful drink for the king's-evil.

295. Take white-wine a quart, juice of pellitory of the wall a pint, ſpirit of wine half a pint, *Sal prunellæ* an ounce; mix and diſſolve them, pour off the clear, and ſweeten with white ſugar. The doſe is ſix ſpoonsfull morning and night.

For the king's-evil.

296. Take roots of pile-wort a ſufficient quantity; bruiſe and boil them in hog's-lard till they are criſp, after which preſs them hard out; and

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE.

Helmont's laudanum, *a general remedy.*

The Laudanum *of the younger* Helmont.

302. Take of opium a quarter of a pound; and of the juice of quinces four pounds at the leaſt; cut the opium very ſmall, and mix it well with the juice, firſt made luke-warm; and then digeſt them with a moderate heat, for eight or ten days. After this, filter the tincture; and infuſe therein of cinnamon, nutmegs, and cloves of each an ounce, or an ounce and half; and let them ſtand for three or four days, or a week longer; then filter the liquor once more, having juſt let it boil a very little, after the ſpices were put in. Now evaporate the ſuperfluous moiſture, till the remainder acquires the conſiſtence of an extract; laſtly, incorporate well herewith two ounces of the beſt ſaffron, reduced to fine powder; or as much of the extract as the ſame quantity of ſaffron wou'd afford. The medicine might be brought to the conſiſtence of a maſs fit for pills; a form wherein I have often adminiſtred it; and upon occaſion too, it might be kept liquid; and if that were the deſign, the evaporation muſt have been but gentle. The doſe of the liquid ſort may be from five drops to ten, as circumſtances ſhall require; but of the pills, a leſs quantity muſt be uſed.

For the leproſie.

For the leproſie.

303. Take pomatum one ounce, flower of ſulphur one dram, *Sal prunellæ* half an ounce; and having mixt them very well together, anoint the part affected therewith, from time to time, as there is need.

A ſimple antimonial remedy, that has often done much good, even in the leproſie, and continual fevers.

304. Of fine crude antimony, in powder, give about one, two, or three ſcruples morning and evening, according to the age of the patient, in a little ſyrup of clove-july-flowers, or any ſuch vehicle; or elſe mixed with fine ſugar, enough to make it palatable. This may be continued for four or five months, if need require: but if the firſt doſe prove beneficial to the patient, and the caſe not urgent, a ſcruple, or half a dram may ſerve the turn; nor need the exhibition be continued for ſo long a time.

An often experienced antimonial infuſion.

305. Take one ounce of powder'd antimony, tied up in a little linen bag, and hang it in a gallon of new beer or ale. This liquor, when 'tis ripe, let the patient uſe for ordinary drink; only, if by age or accident it grow ſour, no more muſt be drank, leſt the acidity of the liquor corroding the antimony, ſhould make it vomitive.

To appeaſe ſcorbutic pains in the limbs.

306. Spread liquid ſtyrax thin, upon ſilk, or very fine kid-leather; and keep it upon the part affected, till it dry up of it ſelf, or till the patient has no more need of it. *Limbs pain'd.*

An experienced medicine for a contracture, produced by keeping the limbs too long in an undue poſture.

307. Anoint well, once or twice a day, the part affected, with dogs-greaſe; chafing it with a warm hand, and keeping the part warm afterwards.

For the dyſentery, and other ſharp fluxes.

308. Take the ſtalks and leaves of flea-bane, dry them gently till they be reducible to powder; of which give about one dram at a time, twice or thrice a day, in any convenient vehicle; or elſe incorporate it with conſerve of red roſes. *Looſeneſs.*

A remedy often uſed with ſucceſs in fluxes, and dyſenteries.

309. Cut freſh roots of biſtort into thin ſlices, and moiſten them well with fair water and wine, to make them more ſoft; then preſs out the juice ſtrongly; and of this give about three or four ſpoonsfull in red wine, or ſome other convenient liquor.

A ſucceſsful medicine for fluxes of the belly.

310. Mix with rice-meal about a fifth part of finely powder'd chalk; boil theſe in water, or in milk, like a haſty-pudding, to be moderately ſeaſon'd with ſugar, and powder'd cinnamon; and let the patient eat it at meals.

For a looſeneſs.

311. Boil a convenient quantity of cork in ſpring-water, till the liquor taſte ſtrong thereof; and of this decoction let the patient drink a moderate draught, from time to time, till he finds himſelf reliev'd.

For a looſeneſs.

312. Mix up 15 grains of powder'd rhubarb, with half a dram of diaſcordium; and let the patient take it either going to bed, or early in the morning, after his firſt ſleep.

An experienced remedy for ſharp fluxes of the belly.

313. In a pint of new milk diſſolve two ounces of loaf-ſugar, and about the bigneſs of a walnut of mithridate; give this mixture, moderately warm, for a glyſter, to be repeated if there be occaſion.

To ſtop fluxes, and the whites.

314. Give the patient, from time to time, a moderate quantity of a decoction of half an ounce of iſing-glaſs, in about a pint of new milk.

For fluxes, eſpecially thoſe cauſed by ſharp humours.

515. Thoroughly drench a toaſt in good olive-oil, and let the patient eat it.

An excellent remedy againſt fluxes.

316. Boil unſalted butter gently, till a conſiderable part be conſumed, ſkimming it from time to time, whilſt it ſtands over the fire: of this butter melted, give now and then a conſiderable quantity, as the patient is able to bear it. This medicine was very ſucceſsful in *Ireland*.

An often try'd glyſter in fluxes, eſpecially from ſharp humours, and in ſome other diſtempers of the bowels.

317. In a quart of new-milk, boil two ſmall ſpoonsfull of groſly powder'd rice, to the conſiſtence of cream, then diſſolve in it two ounces of ſheep-ſuet; and having ſtrain'd it, give it, at once, for a glyſter.

For ſuppreſſion of the Menſes.

Menſes ſuppreſs'd. 318. Give, for three mornings together, about the expected time of the evacuation, a dram of the galls and livers of eels, dried and powder'd.

A good medicine to increaſe milk in ſuch as give ſuck.

Milk to increaſe. 319. Make pottage with lentils, or vetches, and let the patient uſe it freely.

To encreaſe milk in nurſes.

320. Dry well-cleanſed earth-worms, ſo that they may not ſmell ill, and yet be pulverable. Of theſe, reduc'd to powder, give half a dram, or two ſcruples, for a doſe, in wine, or any other proper vehicle.

For diſorders in the nervous ſyſtem.

Nerves diſorder'd. 321. Take of the freſh roots of the male piony one ounce, of the ſeeds of the ſame plant two drams; and with a ſufficient quantity of the ſyrup of piony, or ſome conſerve of a like nature, beat them up into an electuary; of which the patient may take the quantity of a ſmall nutmeg, or more, twice or thrice a day.

For obſtructions, and ſeveral diſeaſes from thence proceeding.

Obſtructions. 322. Let the patient drink, every morning faſting, a moderate draught of his own urine, newly made, and whilſt 'tis yet warm; forbearing food for an hour or two after it.

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MEDICINE.

by two rectifications from phlegm and feculencies, in tall glaſſes, with a very gentle heat. The doſe is from eight or ten drops of the ſpirit, or as many grains of the ſalt, to ſixty times the quantity of either, in any vehicle, except milk, that is not acid. Theſe medicines have been ſerviceable in the epilepſy, convulſions, in fevers, obſtructions of the ſpleen, liver, womb, *&c.* and commonly prove diaphoretic, without heating the blood too much. Only they ſhou'd not be exhibited when the *prima viæ* are block'd up by groſs humours. 'Tis proper to preſerve this ſalt in the ſpirit; otherwiſe 'tis apt to fly away.

An experienced medicine for the pains of the hemorrhoids.

The piles. 329. Take the ſole of an old ſhoe, worn by ſome man that walks much, cut it in pieces, and burn it to a friable, tender coal; reduce this to impalpable powder, and then, with a ſufficient quantity of unſalted lard, make it into an unguent, wherewith the part affected is to be anointed from time to time.

For the hemorrhoids.

330. Uſe a ſuppoſitory of hogs-lard, bacon, or gooſe-greaſe.

For the hemorrhoids.

331. In the yolk of an egg, or ſome convenient ſyrup, or conſerve, give from half a dram, to one dram; of flower of brimſtone, once, or, if the caſe be urgent, twice a day. The powder may be, alſo, given in milk to thoſe who like it.

An internal remedy for painful hemorrhoids.

332. With about two ſcruples of choice ſulphur vive, mix a little ſugar, and give this doſe once or twice a day.

For the pain and tumour of the hemorrhoids.

333. Take freſh leeks, the whole plant, ſhred ſmall, fry them well with freſh butter, till they become fit for a cataplaſm, to be apply'd very warm to the part affected, and renewed from time to time.

An uſeful medicine for the pain of the hemorrhoids.

334. Make up flower of brimſtone, and an equal weight of fine ſugar, with a ſolution of gum-dragon, into tablets that may weigh about a dram each; one of which may be given twice a day.

For the pain of the hemorrhoids.

335. Mix up *Album Græcum*, reduced to an impalable powder, with a ſufficient quantity of gooſe-greaſe; and by grinding it well in a leaden mortar, bring it to a black ointment, to be apply'd moderately warm to the part affected.

An

An experienced remedy for unbroken hemorrhoids.

336. Incorporate calcin'd oyſter-ſhells, with as much honey as will make up the powder into an ointment; with which the part affected is to be tenderly anointed from time to time.

A very ſucceſsful medicine for the hemorrhoids.

337. Take maiden-leeks, that is, thoſe which have never been tranſplanted, and caſting away the green part, make of the bulbous one, and a ſufficient quantity of whole oatmeal, a caudle, whereof let the patient eat plentifully.

For the pain of the hemorrhoids.

338. Boil a handfull of yarrow, in about a pint and a half of poſſet-drink, in a cover'd veſſel, till it be ſtrong of the plant; and of this decoction let the patient drink, pretty plentifully, from time to time.

For the pain of the hemorrhoids.

339. Take of maſtic, olibanum, aloes, and myrrh, of each a like quantity, powder and mix them very well; then lay a ſufficient quantity of this upon a pledget of lint, moiſten'd throughly with ſpirit of wine, over a few well-kindled coals, that the powder may melt, and be clapt hot to the pit of the ſtomach, or navel.

For the pain of the hemorrhoids.

340. Boil a quart of new milk for a while; then taking it off the fire, preſently put it into ſome open-mouth'd veſſel, and let the patient ſit to receive the fumes of it.

To appeaſe the pains of the hemorrhoids.

341. Roaſt two freſh eggs pretty hard, then peel off the ſhells, and mince them. To theſe add two pippins, the cores being firſt taken out, that have been thoroughly roaſted; incorporate them very well with the eggs, reducing all to a kind of cataplaſm, to be apply'd very warm to the part affected.

For pains of the hemorrhoids.

342. Boil half a dram of good flower of brimſtone, a little, in new milk, and let the patient take, in the morning faſting, both the liquor and the powder, for many days ſucceſſively. The like doſe may, upon occaſion, be taken between 4 and 5 in the afternoon.

An

Medicinal Experiments.

An experienced remedy for the piles.

343. In 4 ounces of ſpring-water, diſſolve one dram of ſalt of tartar, and apply ſoft figs dipt in it, warm, to the part affected, ſhifting them from time to time.

For the piles.

Take the powder of earth-worms, waſh'd in white-wine, and incorporate it with as much hens-greaſe, as will ſerve to make it up into an ointment. Apply this to the part affected.

For tumours and pains of the hemorrhoids, not too much inflamed.

345. Let the patient dip his finger in balſam of ſulphur, made with oil of turpentine, and anoint the tumours, whether external or internal, once or twice a day.

For the pains of the piles.

346. Take of myrrh, olibanum, and common frankincenſe, of each a like quantity; having powder'd them, mix them very well, and let the patient receive the fumes of this mixture, caſt upon a chafing-diſh of embers, in a cloſe-ſtool, for about a quarter of an hour.

To appeaſe the pain of the hemorrhoids, whether internal or external.

347. Take two parts of flower of ſulphur, and one of ſugar, very finely powder'd; mix them exactly together, and make them up with a ſufficient quantity of mucilage of gum-dragon, into lozenges of about a dram each: of which you may give one at a time, thrice a day, or, if need be, 4 or 5 times.

For the piles.

348. Take balſam of ſulphur made with oil of turpentine, and ointment of tobacco, equal parts; incorporate them well, and anoint the grieved place therewith.

Aloetic pills that ſcarce occaſion the piles.

349. Give of the *Frankfort* angelical pills, from one ſcruple to two ſcruples, or more, for a doſe.

A medicine for the pain and tumour of the hemorrhoids.

350. With rags dipt in the patient's own urine, foment the parts affected, and then anoint them with ointment of populeum. This do three or four times a day; and if the tumours be internal, you may inject a little of the urine.

A remedy,

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE.

A try'd way to make an artificial wine, that is ſoon drinkable, and ſerves to keep the body ſoluble.

357. Pour a gallon of boiling water upon three pounds of raiſins of the ſun, ſton'd and well bruis'd; by ſqueezing and preſſing, get out the juice; and having ſtrain'd it, add thereto a pound of brown ſugar-candy.

An approved outward medicine to cauſe reſt without opiates.

Reſt to cauſe. 358. Take of toſe-water eight ounces, good wine four ounces, ſtrong vinegar two ounces; mix theſe well, and having warm'd ſtupes in the liquor, therewith foment the part affected, laying them on moderately warm, and taking them off when they begin to grow cold: keep fomenting between a quarter, and half an hour, before the patient compoſes himſelf to reſt.

A good medicine for rheums, or a cold newly taken.

Rheums. 359. To four ounces of ſpring-water put three leaves of colts-foot, a pugil of maiden-hair, and one dram of ſtick-liquorice: when the water is ready to boil, put in the fore-mentioned ingredients; let it boil a little, then take it off the fire, and having preſently ſtrain'd it, let the patient drink it hot, like tea, whilſt he is in bed: do this three or four nights ſucceſſively.

A very good ſyrup for thin rheums.

360. Take the ſyrups of iujubes, dried roſes, and of corn-poppy-flowers, of each a like quantity; mix and uſe them as neceſſity requires.

A powerful medicine to ſtop ſharp rheums.

361. Take a dram of *Japan* earth, and make thereof a decoction in five or ſix ounces of white-wine, or ſome diſtilled water. Of this give two or three ſpoonsfull night and morning.

A ſucceſsful remedy for a kind of rheumatiſm, and a contracture of the limbs that followed upon it.

The rheumatiſm. 362. Take the inward bark of an elder-tree, cut it into ſmall bits, and with them, looſely placed, fill about the third part of a bottle; then pour in as much ſmall ale, or beer, as will fill up the remaining part of the veſſel; ſtop it well till the liquor taſte ſtrong of the bark; and let the patient drink a draught once or twice a day; or, if he can, let him take it as a diet-drink.

Ens veneris, *an experienced ſpecific for the rickets.*

The rickets. 363. Calcine good *Dantzick*, or rather *Hungarian* vitriol, till the calx become of a dark red, or purpliſh colour; then thoroughly dulcify it,

by repeated waſhings in warm water, dry it, and mix it exquiſitely with an equal weight of pure ſal-armoniac in powder; put the mixture into a glaſs retort, able to hold above three times the quantity, and ſublime it in a ſand-furnace, by degrees of fire, for ten or twelve hours; increaſing the fire at the laſt, till the bottom of the retort be red-hot. If what is ſublimed, which is the medicine, be not of a good yellow, return it to the remainder, mix it well therewith, and ſublime it once more. The doſe is two or three grains to little children, ten or twelve to grown perſons, and ſometimes twenty or thirty, in diſtilled water, or ſmall-beer, but not in milk. It may be given at any time, upon an empty ſtomach; but I moſt commonly give it at bed-time. When it operates ſenſibly, 'tis by ſweat, and, ſometimes, by urine. I exhibit this medicine, alſo, in fevers, and other diſeaſes, to procure ſleep, which it does more ſafely than opiate preparations. 'Tis, alſo, powerful againſt worms, obſtructions of the *menſes*, and to ſtrengthen the appetite.

An effectual medicine for the roughneſs of the lips, and to heal parts that have the ſkarf-ſkin worn off.

364. Take two parts of wax, and one of freſh butter, melt and incorporate them over a gentle fire; and let the mixture drop into ſmall cakes, upon a glazed tile, dipt in water, or a piece of wetted white paper. *Roughneſs of the lips.*

To take off the heat and roughneſs of the ſkin, eſpecially on the lips.

365. Anoint the part affected with freſh cream.

For a rupture, eſpecially in a child, or young perſon.

366. Reduce the root and leaves of dove's-foot-crane's-bill, to fine powder; and of this let the patient take about half a ſpoonfull at night and morning, for three or four weeks together; waſhing it down, each time, with ſome ſpoonsfull of red wine. *Ruptures.*

For ruptures in the belly, eſpecially in children.

367. Having well cleanſed ſome *Solomon*'s-ſeal roots, ſcrape one ounce of them into a quart of broth, and let the patient take a meſs of it for his breakfaſt; or elſe give half a dram, or two ſcruples, of the powder of it, at a time, in any convenient vehicle.

An uſeful drink for a beginning ſcurvy.

368. To a quart of ſmall-beer, put over-night, about a handful of ſcurvy-graſs-leaves; and let the patient drink this liquor at dinner, for ſix or eight weeks together. *The ſcurvy.*

An excellent drink for the ſcurvy.

369. Let two handsfull of water-trefoil work in about eight gallons of wort, inſtead of hops; and let the patient uſe it for his ordinary drink.

For the ſcurvy.

370. From the freſh gather'd tops of fir, a little bruis'd, abſtract ſpirit of wine; and with this liquor draw a deep tincture from other freſh tops; of which tincture reduce ſome part into an extract, whereof to form pills; keep theſe, the tincture, and the impregnated liquor apart, to be employed ſeparately, or conjointly, as occaſion may require.

For ſcorbutic, and other pains in the limbs.

371. With red and unſophiſticated oil of peter, anoint, from time to time, the part affected.

An experienced remedy for a ſhort breath.

Short breath. 372. Take of choice caſtor powder'd, two, three, or four grains; mix this with ten or eleven grains of *Gaſcoign*'s powder, and ſome little ſyrup, or conſerve; and when taken, let it be waſh'd down with a mixture of five drams of peny-royal-water, and two drams of compound bryony-water.

An experienced medicine for want of ſleep, proceeding from great heats in the head.

Sleep to procure. 373. Take the ſcrapings of the paleſt carrots, enough to make a cataplaſm, of about two inches broad, and of the thickneſs of a half-crown. Let the patient apply this, in a piece of double linen, to his throat, ſo that it may reach to the jugular veſſels on each ſide, when he goes to bed, and let it lie on all night; if the firſt application do not prevail, 'tis to be apply'd the following night; and ſo a third and fourth time, if need require.

An experienced medicine for the ſmall-pox, eſpecially in children.

Small-pox. 374. Take the little balls of freſh ſheeps-dung, and having freed them from ſtraw, duſt, &c. put a handfull of them, thus cleans'd, into a quart of good white-wine; and in a veſſel well ſtopt, let them infuſe in a moderate heat, till the liquor be well impregnated. Strain this infuſion, and give of it warm about a ſpoonfull at a time, once in two or three hours, or oftener.

For heat about the orifice of the ſtomach.

Diſorders in the ſtomach. 375. Make a ſyrup with the juice of houſleek and ſugar, and give about one ſpoonfull of it from time to time.

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MEDICINE. a whole dram of it at a time, in a moderate draught of ſome convenient vehicle. That which the diggers name cawk, being white and opake, is not the medicine I mean, but the tranſparent matter, which eaſily breaks into ſmooth fragments, and in the fire cleaves into ſeveral pieces, ſmooth and prettily ſhaped.

A ſafe and eaſy medicine in fits of the ſtone.

381. Take ſack, or claret-wine, and by ſhaking, or otherwiſe, mix with it an equal quantity of oil of walnuts; and of this mixture give from four or ſix, to eight or ten ounces at a time, by way of glyſter.

For the ſtone.

382. Give of the ſeed of flix-weed, about as much as will lie upon a ſhilling, either whole, or groſly bruis'd, in any convenient vehicle.

An anodyne glyſter in the ſtone.

383. Take marſh-mallow roots half an ounce, leaves of the ſame, mallows, and mullein, of each one handfull, camomile-flowers two pugils: boil them in a ſufficient quantity of water to ten ounces, ſtrain, and add the yolks of two eggs, and oil of camomile an ounce and half; mix and make a glyſter.

An excellent medicine in fits of the ſtone.

384. Boil leſs than a handful of red chick-peaſe, or cicers, ſoftly in a quart of ſpring-water, till the liquor be red, and well impregnated with the ſeeds: ſtrain this decoction, and ſweeten it with ſyrup of marſh-mallows, out of which all the ſtronger diuretics are left.

For the ſtone.

385. Sweeten a quarter or half a pint of ſimple arſmart-water, with a little ſugar, or ſome convenient ſyrup; aromatize it with a little nutmeg, and give this mixture for one doſe.

For the ſtone and gravel in the reins and bladder.

386. Take equal weights of common daucus-ſeed, and of burdoc-ſeed; and having mixt theſe together, put one ounce of the mixture to a gallon of ſmall ale, and let the patient uſe it for conſtant drink.

A good liquor to uſe, as drink, in a long fit of the ſtone.

387. Make poſſet-drink of three or four parts milk, and one of white-wine. Into two quarts of this poſſet-drink, ſcrape a nutmeg or two; add a little juice of lemmon, and, if you pleaſe, ſweeten it a little with ſyrup of marſh-mallows. Take of this drink a conſiderable quantity at a time, and uſe it often in a day.

A good

A good medicine for the ſtone.

388. Sweeten a pint, or a quart, of new ale with pure honey, and boil it to the conſumption of about one half, ſkimming it well from time to time. Then diſſolve in it the yolk of a new laid egg; and let the patient drink a large draught of this mixture once or twice a day, till he find relief.

A ſerviceable medicine in an actual fit of the ſtone.

389. Take the decoction, made according to the *London* diſpenſatory, for the ſyrup of marſh-mallows, but with half the quantity of the ingredients. This decoction being well clarified, let the patient take of it warm, ſix, eight, or ten ounces at a draught, from time to time.

A cure for the ſtone; taken out of the hiſtory of Barbadoes, *written by Mr.* Lygon.

390. After the ſtoppage of urine for more than 14 days, the following medicine did not only break, but bring away all the ſtones and gravel. And in about three weeks after, the like pains returning, the ſame medicine had the like effect, within ten hours after the taking thereof.

Beat the dry pizzle of a green turtle, or tortoiſe, which lives in the ſea, to powder; and take of it as much as will lie upon a ſhilling, in beer, ale, white-wine, or the like; and in a very ſhort time it will perform the cure. Theſe creatures are to be had eaſily, both at the *Caribee* and *Lucaick*-iſlands.

To expel the ſtone in a fit.

391. Diſſolve a large proportion of crabs-eyes powder'd, in good white-wine vinegar; and of this drink let the patient take from two ſpoonsfull, to five or ſix at a time.

For the ſtone.

392. Give every morning faſting, and every night going to bed, half a dram of the powder of winter-cherries, in a draught of parſley, or arſmart-water, or in a glaſs of white-wine.

An often try'd medicine for the ſtone, whether of the kidneys or bladder.

393. Take of pure white-wine, or *Rheniſh*, and of fennel-water, each one pint; mix them, and add half an ounce of live wood-lice well cleanſed, and one lemmon ſliced; let them infuſe in a veſſel well ſtopt, for four or five days, and then let the patient take about four ounces at a time twice a day.

For the ſtone.

394. Diſtil arſmart in a common roſe-water ſtill, and give ſome ſpoonfull of the water in or before the fits.

A chymiſt's ſecret for the ſtone.

395. Take borax finely powder'd, and make it up with choice turpentine into pills, whereof one doſe ought to contain from one ſcruple to two; waſh theſe down with a few ſpoonsfull of the tincture of *Lignum Nephriticum*, made in water, or of cochineal; or if the caſe be urgent, you may give from twenty to thirty grains of the borax, and about a fifth part of myrrh, diſſolved in two ſpoonsfull of the tincture of *Lignum Nephriticum*.

To make a nephritic tincture, often found to relieve in the ſtone.

396. Calcine oyſter-ſhells till they be very white; of theſe take two parts, and one of *Rheniſh*-wine tartar; pulverize them apart, and mix them diligently; pour on the mixture a little fair water, and let the ingredients work on each other till the conflict be over; then ſtir the mixture, and pour on more liquor; and when the efferveſcence ceaſes, put on a little more, and ſo proceed till no conflict be made. Evaporate it to a kind of ſoft mucilage; digeſt this a while, decant the liquor, and filter it, and you will have it, if it be not too phlegmatic, of a fine red colour. Of this the doſe is from ten or fifteen, to thirty drops, or more, in any convenient vehicle.

An uſeful aliment for ſuch as are troubled with pains of the ſtone.

397. Let the patient eat five or ſix onions roaſted, and ſparingly butter'd, either in the morning, at meals, or other times, if the caſe be urgent. The diſtilled water of onion is, likewiſe, uſeful in the ſame diſtemper.

The medicine of a famous empiric for the ſtone.

398. Take amber, ſea-horſe pizzle, and nitre, of each a like quantity, (but in caſe of ulcerated kidneys, put only half the quantity of the amber) and an eighth part of nitre. Pulverize each apart, and make them up into pills with *Chio* turpentine; take ſix or ſeven pills (of about ten to a dram) morning and evening.

For the ſtone.

399. Take *Straſburg* turpentine two ounces; grind it well with the yolks of eggs, and mix therewith the following ſyrup. Take water a pint and half, *Sal Prunellæ* an ounce and half; mix, diſſolve, and with a pound of honey, boil all into a ſyrup. The doſe is two or three ſpoonsfull morning and night.

An

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

Medicinal Experiments.

For a freſh ſtrain.

403. Take wormwood, and pound it very well in a ſtone-mortar; then put into it as much of the whites of eggs, beaten to water, as will make it into a poultis, to be applied to the part affected.

A ſtrengthening plaiſter after a ſtrain, or when there is any weakneſs in the joint.

404. Melt down together, and incorporate two parts of diapalma, and one part of *Emplaſtrum ad Herniam*; ſpread this mixture (not very thick) upon leather, and lay it to the joint to be ſtrengthened.

For a freſh ſtrain.

405. Make up clay with as much vinegar, as will bring it to the conſiſtence of a ſtiff cataplaſm: then warm it a little, and apply it to the part affected.

For a freſh ſtrain.

406. Take four ounces of bean-flower, and two ounces of wine-vinegar; of theſe make a cataplaſm, to be applied a little warm to the part affected: but if this ſhould prove too ſharp, boil two drams of litharge a little in the vinegar, before you put in the bean-flower.

For a recent ſtrain.

407. Boil a handful of red-roſe leaves in a pint of claret-wine, for a little while, in a cloſe veſſel, till the liquor be ſtrong of the plant. In this, well heated, dip a piece of linen or flanel, and wringing out the moiſture, double it, and apply it hot to the part affected; uſing a fillet to keep it on.

My lord Bacon's *experienced medicine for a recent ſtrain or bruiſe.*

408. Boil a handful of freſh wormwood, in a ſufficient quantity of ſtrong ale, to the ſoftneſs of a poultis; then take it off the fire, and when you apply it, which you ſhould do whilſt 'tis very hot, put to it a ſpoonfull or two of common brandy.

A plaiſter for a recent ſtrain.

409. Take equal parts of the plaiſters called diapalma and oxycroceum, make of them a compounded plaiſter, to be ſpread upon thin leather, and apply it to the part affected, rnewing it, if need be, twice a day.

A remedy

A remedy for a recent ſtrain.

410. Take two ſpoonsful of vinegar, and beat into it very well the white of an egg; and ſpreading it upon flax, or tow, apply it to, and keep it on the part affected.

For a freſh ſtrain.

411. Boil brain in wine-vinegar to the conſiſtence of a poultis; apply it warm, and renew it once in twelve hours, for two or three times.

To ſtrengthen a part weakned by ſublaxation.

412. Spread *Emplaſtrum Divinum* upon ſoft leather, and apply it; keeping it on for ſome time.

An effectual medicine for a ſtrain.

413. Take comfrey-roots, beat to a pulp, half a pound, powder of *Japan* earth four ounces, ſpirit of wine a ſufficient quantity; mix and apply it to the part.

A plaiſter to ſtrengthen the joints after the gout, and haſten the going off of the pain.

414. Take of paracelſus and diapalma, of each a like quantity, melt and incorporate them exactly together, and ſpread the mixture, very thin, upon fine leather, to be us'd as a plaiſter to the part affected.

A medicine, almoſt ſpecific, for a teneſmus.

415. Mix balſam of ſulphur terebinthinated with linſeed-oil, or ſome other convenient oil, till the balſam be thereby ſo far allay'd, that the patient may well endure it; and then let him dip his finger therein, and uſe it as a ſmall ſuppoſitory two or three times, or oftner in a day. *Teneſmus.*

An experienced medicine to kill tettars and the itch.

416. Take of flower of brimſtone, ginger, and burnt-alum, of each a like quantity; mix them well, and of this mixture incorporate as much with new unſalted butter, as will bring it to the conſiſtence of an unguent. With this anoint the part affected, as hot as the patient can well endure it, and let it ſtay on all night; the next morning waſh it off with celandine-water. But when the patient goes to bed, he is to take a doſe of ſome alexipharmic medicine, as *Gaſcoign*'s powder, *&c.* to keep the humour from the maſs of blood: he is, alſo, to bathe the part often in a day, with celandine-water. *Tettars.*

MEDICINE.

Tooth-ach, and other diſorders in the teeth.

A remedy almoſt ſpecific for the tooth-ach.

417. Into a quart of red wine, put one dram of alum, and another of acorns, a dram and a half of galls, and half a handful of dry'd red roſe-leaves. Boil to the conſumption of near half, and then take it from the fire; ſtrain it, and diſſolve in it a dram of *Acacia*, cut ſmall; and with this liquor, a little hot, waſh the part ſeveral times in a day. 'Tis alſo excellent to faſten looſe teeth, being uſed in the ſame manner.

An uſeful remedy for the tooth-ach.

418. Let the patient lie on the ear that is oppoſite to the part affected, and into the other ear let fall two or three drops of the freſhly expreſt juice of rue, a little warm, and ſtop the ear lightly with fine black wool, or cotton.

A very ſucceſsful external remedy for the tooth-ach.

419. In the decline of the moon, in *Auguſt*, take the fruit called hipps, with all the fuzzy ſtuff that grows upon it; and wrapping it up in a piece of thin ſarcenet, tie it upon the arm, of the ſame ſide with the part affected, and keep it on as long as there is need.

For the tooth-ach.

420. Take a handful of red ſage, and a handful of clary; ſhred them ſmall, beat them, and ſprinkle them with *May* dew; then ſtrain out the juice, put it in a glaſs bottle, and ſet it in the ſun in a window; and when you uſe it, put three drops into a ſpoon, heat it over a candle, and drop it, blood-warm, into the ear; and let the patient eat a cruſt of bread, wet either in broth or poſſet, and chew it upon the teeth that ach.

A good compoſition to ſtop a hollow tooth, and appeaſe the pain.

421. Take two parts of fine ſugar, and one part of black round pepper, both finely powder'd and mixt; put them into a ſilver ſpoon over two or three well-kindled coals: and when the ſugar begins to melt, take off the ſpoon; and whilſt the mixture is yet ſoft, form it into little grains, for ſize and ſhape ſuited to the part affected.

To faſten looſe teeth.

422. Put maſtic, finely powder'd, upon the end of a handkerchief, rub your teeth therewith twice or thrice in a day; and chew maſtic often. Alſo boil pomegranate-flowers with mint or maſtic, in claret wine; and gargle, or waſh your mouth often with it.

A medicine preſcrib'd to K. Charles I. *to faſten the teeth.*

423. To a pint of ſpring-water put four ounces of brandy; let the patient waſh his mouth with the mixture every morning, and twice or thrice a day beſides; and let him, in the morning, roll, for a little while, a bit of roch-alum in his mouth.

An

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For the tooth-ach.

433. Apply a plaiſter of *Caranna*, between the bottom of the ear and the temples, on the ſide where the pulſation of the artery is the moſt manifeſtly felt.

A good medicine for pain of the teeth, proceeding from rheum.

434. Put of the powder of white hellebore, into a clean linen rag, like a nodule, about the bigneſs of a large pea; and let the patient hold it between his teeth, with his head and face ſomewhat inclined, that the rheum may run freely out of his mouth.

For the aching of a hollow tooth.

435. With oil of wax moiſten a little cotton, and thruſt it up into the tooth; letting it lie there till the pain be aſſwaged.

A powerful and experienced topic for a ſore throat.

Throat diſordered.

436. Take two new laid eggs, roaſted moderately hard, and the pap of two well roaſted pippins; beat them well together, and add an equal weight of poſſet-curd, made with ale. Having incorporated them all, apply the mixture very warm to the part affected; ſhifting it once in five or ſix hours.

An approved remedy for a ſore throat.

437. Take verjuice of grapes one ounce, honey half an ounce, crude alum a dram and half, ſea-ſalt half a dram; powder the ſalts finely, and incorporate them very well with the liquors into the form of a liniment: in this dip a long feather, and with it touch the part affected, gargling, between whiles, with a mixture of plantain, and red roſe-water.

An external remedy for a ſore throat.

438. Sew live millepedes between the foldings of a piece of linen, and apply them to the throat, in the form of a ſtay, to be kept on all night.

A try'd remedy for a ſore throat.

439. Take bay-ſalt dry'd, and powder'd; put it into the folds of a rag, in a ſufficient quantity to make a ſtay, to be ty'd about the throat; and apply it over night, as hot as the patient can endure it.

For a ſore throat, eſpecially if inflamed.

440. Take a little handful of the leaves of common mallows, and eight or ten figs; boil theſe for a quarter of an hour in a pint of new milk, and let the patient uſe it very hot and often.

An

An experienced medicine for a ſore throat.

441. Take one dram of *Album Græcum*, burnt to perfect whiteneſs, and with one ounce of honey of roſes, make a linctus, to be very ſlowly let down the throat.

An experienced medicine for a ſore throat.

442. Into the foot of a worſted ſtocking, that has been long worn, put a ſufficient quantity of good ſea-ſalt, well dried, or decrepited; and this ſalt being put in warm, the ſtocking is to be tied about the patient's neck, and kept all night. If by the next day the diſtemper be not removed, you may apply freſh ſalt, in the ſame ſtocking as before, on the night following.

A try'd medicine for a ſore throat, cauſed by acid humours in the internal parts of it.

443. Boil half a handful of the leaves of common mallows, in a pint of new milk, for half an hour; then run it through a clean cloth, and let the patient uſe it, a little warm, three or four times a day, as a gargle: or elſe let him hold it in his mouth, ſuffering ſome drops to ſlide ſlowly down his throat.

For a ſore throat.

444. Take a piece of greaſie linen-cloth, which, being doubled, may make a bag, in form of a ſtay, to reach from one ſide of the throat to the other, and contain as much matter as may make it an inch thick. This bag being fill'd with common ſalt, is to be heated throughly, and apply'd to the part affected, as warm as the patient can conveniently endure; and when it begins to grow too cold, another like it, and well heated, is to be ſubſtituted in its room: and whilſt this is cooling, the other may be heated, and made ready for uſe; ſo that the part affected be always kept in a conſiderable degree of warmth, for about 48 hours, if the remedy be ſo long needed.

For a ſore throat.

445. Take the white of a new laid egg, by beating reduced into water; and with this mix ſo much conſerve of red-roſes, as will bring it to a ſoft maſs; whereof the patient is to let a little bit at a time melt leiſurely in his mouth.

For a ſore throat.

446. Take houſleek, and having lightly beat it in a ſtone-mortar, preſs out the juice hard; to this juice put almoſt an equal quantity of virgin-honey; mix them well, and add a little burnt alum, to give it a diſ-

MEDICINE. diſcernible aluminous taſt: let the patient take this from time to time, with a liquorice-ſtick.

An experienced medicine for ſore throats.

447. Take of ſcabious-water ſix ounces, of wine-vinegar a ſmall ſpoonful, of beaten muſtard-ſeed, and of honey, each a ſpoonful; ſtir and ſhake them very well together; then filter the mixture, and uſe it as a gargle.

For a ſore throat.

448. Make a plaiſter of paracelſus, three or four fingers broad, and long enough to reach almoſt from one ear to the other; apply it to the part affected, ſo that it may touch the throat as much as poſſible.

A gargle for a ſore throat.

449. To four ounces of plantain-water, add three or four ſpoonsful of red roſe-water, and mix very well with theſe the white of an egg beaten to a glair: ſweeten the mixture with a ſmall ſpoonful of white ſugar-candy, and let the patient uſe it often.

An excellent medicine for tumours in the throat, and ſome other parts.

450. To a quart of new milk, put a handful of mallow-leaves, with as much of the leaves of night-ſhade, ſhred ſmall; let them boil, till the herbs be tender. Then put into the milk as much crumbs of white bread, as being ſtirr'd well with the other ingredients, will bring all to the conſiſtence of a poultis. This is to be ſpread upon a ſtay for the throat, or ſome other thing fitted to the part affected, and to be laid on as hot as the patient can well endure it; and when it begins to grow cold, it is to be ſucceeded by freſh, made very hot, as the caſe ſhall require.

A remedy almoſt ſpecific, for the thruſh in children.

The thruſh. 541. Mix freſh juice of houſleek with honey enough to make it ſweet, and then add to it as much finely powder'd roach-alum, as will give it a little tartneſs; put ſome of this mixture, with a feather, down the patient's throat, as far as conveniently may be: the part affected ſhou'd alſo be touched once more within an hour after.

For the thruſh in young children, or a ſore mouth.

452. Fill an egg-ſhell with the juice of red-ſage, ſet it on hot embers till it boil, and ſkim it whilſt any ſkum ariſes; then take the quantity of a pea of powder'd alum, and half a ſpoonful of honey, and let this be put in the egg, and boil it a little; and when cold, rub the child's mouth herewith as often as you ſee cauſe.

An

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

MEDICINE.

A rough emetic, by which the venereal diſeaſe has been often cured.

Venereal diſeaſe. 460. Take good mercury ſublimate, and *Venice*-treacle, of each one ounce; mix them together, and put them into a quart of ſpring-water; ſet them *in balneo*, to diſſolve in a cloſe veſſel; and of this liquor well ſettled, let the patient take about half a ſpoonful, or a ſpoonful, but never above a ſpoonful and a half, in four ounces of warm ſmall ale, in the morning faſting, and once in the afternoon, or evening; the ſtomach being empty. Every ſecond day intermit, and give a gentle purge.

Againſt a vertigo.

Vertigo. 461. Take of cyprus-roots two ounces, of aniſeed half an ounce; make of them a very fine powder, and give as much as will lie on a ſix-pence, in a ſpoonful of wine, beer, or ale; going to bed.

A ſlow, innocent way of making veſicatories without cantharides.

Veſicatories to make. 462. Put to a handful of crows-foot, about half a ſpoonful of muſtard; and beat them very well together, to the conſiſtence of a poultis, to be ſpread thick, and kept on for twelve or fourteen hours.

A good medicine to raiſe bliſters.

463. Upon half an ounce of powder'd cantharides, put two or three ounces of good ſpirit of wine; let them lie together for four or five days, that the ſpirit may acquire a good tincture; then filter it, and dip into it a piece of linen cloth, ſix or eight times double, and of the figure and ſize deſired. This cloth being throughly wetted, and cover'd with a melilot plaiſter, to keep it on, muſt be applied to the part. At the end of five or ſix hours, you may take off the plaiſter and the linen cloth, and find the bliſter raiſed.

To raiſe a bliſter without cantharides.

464. The ſeed of *Clemmatis Peregrina*, being bound hard upon any part, will, in an hour or two, have an operation, like that of another veſicatory.

A water for ulcers and ſores.

Ulcers. 465. Take a ſolution of *Venetian* ſublimate; and having made, with very good quick-lime, as ſtrong a lime-water as you can, drop this upon the diſſolved ſublimate, till it precipitates no more reddiſh matter: as ſoon as you perceive the liquors act no longer upon one another, pour the mixture into a filter of cap-paper; which, retaining the orange-coloured precipitate, will let paſs an indifferently clear liquor, to be kept ſtopt in a glaſs vial. The part affected may be herewith waſh'd, from time to time; and, if need be, cover'd with double linen cloths, wetted in the ſame.

A famous empirical medicine for a ſtubborn ulcer.

466. Lightly burn to aſhes, the groſs ſtalks on which the red cole-wort grows, and, with any fit addition, make a cataplaſm, to be apply'd to the ulcer; and ſhift it at reaſonable diſtances of time.

A try'd medicine to make a quick exfoliation of a carious bone.

467. Take the thigh-bone of a man, and having burnt it black, reduce it to a fine powder, to be carefully ſtrewed all over the part to be exfoliated, after ſome drops of chymical oil of ſavin have been employ'd to wet and ſoften the part, and make the powder ſtick well: thus done, dreſs it up, and 'twill ſeldom require a third application.

A try'd medicine for an ulcer in the womb.

468. Of true *Bitumen Judaicum*, reduced to very fine powder, let the patient take above a dram at a time, in any proper vehicle, once or twice a day.

An aſtringent liquor, of great uſe in ulcers, and ſome wounds.

469. Boil two drams of choice *Catechu*, or *Japan* earth, in a quart of ſpring-water; pour off the clear, and with it, by injection, or otherwiſe, dreſs the ulcers or wounds.

For outward ulcers.

470. Take the green bark of oak, and chop it all together, both inſide and outſide, in very ſmall pieces; pour thereon good lime-water freſh made, and let it infuſe, till the liquor has acquir'd a deep tincture. With this dreſs the ulcer once or twice a day.

A ſucceſsful water for ulcers and ſores.

471. To a quart of ſpring-water, add one dram of mercury ſublimate, finely powder'd; and when 'tis quite diſſolv'd, drop into the ſolution, ſpirit of ſal-armoniac, till no more will manifeſtly precipitate. Then filter the mixture through cap-paper, and reſerve the precipitate for other uſes. The liquor that paſſes keep cloſe ſtopt in a glaſs; and when you uſe it, dip linen rags therein, and apply them to the part affected twice or thrice a day.

A ſpeedy remedy for fits of vomiting.

472. Take a large nutmeg, grate off one half of it, and toaſt the flat ſide of the other, till the oily part begin to ouze out; then clap it to the pit of the patient's ſtomach, as hot as he can well endure it, and let him keep it on whilſt it continues warm; and then, if need be, put on another. *Vomiting.*

Medicinal Experiments.

Emetic drops.

473. In compliance with ſome ingenious phyſicians, and others, who have often employ'd a medicine, that goes under the name of my emetic drops, I ſhall communicate the preparation of them; without preſſing their uſe any otherwiſe, than by declaring, that ſeveral practitioners in phyſic, of differing ſentiments, agree in aſſuring me, they have not yet found any emetic to work ſo effectually, nor with more eaſe and ſafety, than this liquor; which ſome of them prefer, by much, to other antimonial vomits; and eſpecially to the infuſion of *Crocus Metallorum*.

In preparing my vomitive liquor, I have not always employ'd the ſame proportion of the ingredients 'tis made of; nor did I find it neceſſary to be nice in this particular. But the proportion I ſomewhat prefer, is to take two parts of well choſen and finely powder'd antimony, and three parts of ſpirit of wine; which ought to be rather moderately ſtrong, than too much rectified. Theſe are to be diſtill'd together in a glaſs retort, fitted with a large receiver, till there come over a great part of the menſtruum; which will uſually, towards the cloſe, be accompanied with red flowers, that muſt be ſeparated by filtration through cap-paper; and the clear liquor put into a glaſs, not newly waſh'd, but dry on the inſide, to be kept cloſe ſtopt from the air.

The doſe is uſually, to grown perſons, eſpecially at the firſt time, from four or five, to ſeven or eight drops. The vehicle may be a ſpoonful or two of wine, black-cherry water, or ſpring water; drinking up the liquor immediately after mixing, becauſe there will ſome precipitation be made; and then taking two or three ſpoonsful of the ſame vehicle to waſh it down. It uſually begins to work early, and does it without cauſing near ſo much ſtraining as vulgar emetics, and yet makes large evacuations. Having had occaſion to keep long by me ſome vials of theſe emetic drops, I obſerv'd, that in time, there began to ſubſide a white powder, wherein a large part of the vomitive faculty of the medicine may be ſuppos'd to reſide; therefore 'twill be beſt either to employ the liquor ſoon after 'tis made, or to ſhake the vial well, juſt before 'tis adminiſtred.

For ſharpneſs of urine.

Diſorders from the urine.

474. Take of the dry matter that divides the lobes of the kernels of walnuts, beat it to powder; and of this give about half a dram at a time, in a draught of white-wine, or poſſet-drink made with it, or any other convenient liquor.

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MEDICINE.

A medicine almoſt ſpecific for the ſuppreſſion of urine.

483. Infuſe two handsful of the flowers of *French*-lavender, in a good heat, in a pint of brandy; and of this infuſion give a ſmall wine-glaſs full at a time.

A try'd medicine for a ſuppreſſion of urine, that is not very obſtinate.

484. Diſſolve half an ounce of choice *Caſtile* ſoap, in half a pint of white-wine, or ſome appropriated liquor; paſs the ſolution through a woollen filter, that the more unctuous parts may reſt behind, and the liquor paſs more clear; put to this five or ſix grains of ſaffron: divide it into two doſes, whereof one is to be given a few hours after the other, if the firſt do not operate well.

An experienced remedy for making bloody urine.

485. Take the waters of the black alder, and of mallows, of each three ounces, ſyrup of comfrey one ounce; mix them, and let the patient take four ſpoonsful four or five times a day.

A powerful diſſolving ointment for warts and tumors.

For warts. 486. Take *May* butter, having melted it in a moderate heat, mix with it, by little and little, as much oil of tartar *per diliquium*, as will give it a ſenſible ſtrong taſt.

An empiric's boaſted remedy for the whites.

The whites. 487. Make a ſtrong decoction of the herb ladies-mantle, and let the patient drink of it about half a pint every morning faſting; and if the caſe be urgent, make an injection of the ſame plant, boiled very tender, and let the patient make uſe of it from time to time.

An excellent remedy for the whites in women.

488. After due purging give two, three, or four grains of laudanum; and inject four or ſix times a day, the following.

Take ſpring-water two quarts, white vitriol, and roch-alum, of each two ounces: powder, mix, and diſſolve. Let the liquor ſettle, and uſe only the clear.

A powerful medicine for the whites.

489. Shred into a pottle of ale, two ounces of white iſing-glaſs, and in a looſely ſtopt veſſel, let the liquor ſimmer till about half is waſted; ſtrain the reſt, and give of it two or three ounces at a time, once or twice a day.

For

For a whitlow.

490. Beat ſhell-ſnails very well, with a convenient quantity of parſley, to be applied warm to the affected part, and ſhifted two or three times a day. *Whitlows.*

A try'd medicine for a whitlow.

491. Beat houſe-ſnails, ſhells and all, in a ſtone-mortar, till they be reduced to the conſiſtence of a cataplaſm; which apply ſomewhat warm to the part affected, and keep it on for ſixteen or twenty four hours, renewing it occaſionally.

An excellent remedy for whitlows on the fingers.

492. Take a reddiſh or blackiſh ſnail, of the ſort that has no ſhell, and having beaten it in a ſtone mortar to the conſiſtence of a poultis, apply it to the part affected; renewing it once or twice, after it has been kept on for ſome hours.

For women in labour, to bring away the child.

493. Let the patient take about one dram of choice powder of myrrh, in a draught of *Rheniſh* wine or ſack; or ſome other more temperate vehicle. *Womb-medicines.*

An often proved remedy to cleanſe the womb of a lying-in-woman.

494. With the juice of ſheeps-ſorrel, and ſome of the ſtrong infuſion of the ſame herb, made in water, and a ſufficient quantity of ſugar, make a ſyrup: of which let the patient take about a ſpoonful twice or thrice a day.

An experienced medicine to cleanſe the womb.

495. Take a large white onion, cut it into ſmall pieces, and boil it in a pint of water, or leſs, as if it were to be dreſſed for eating. And of this decoction give ſeven or eight ounces for a doſe, mix'd with about half an ounce of freſh oil of walnuts.

To cleanſe the womb, eſpecially after child-bearing.

496. Take a large white onion, about four ounces in weight, and boil it in about a pint of water, with any thing fit to make a very thin broth, till a third part, or more, of the liquor be conſumed: of this broth, which may be made a little palatable with nutmeg, &c. the patient is to take ſix or eight ounces, twice or thrice a day.

For

For a Prolapſus Uteri.

497. Apply to the patient's navel a pretty large cupping-glaſs; but let it not ſtay on above a quarter of an hour, for fear of injuring the part it covers.

A good vehicle for ſeveral remedies, being of itſelf uſeful againſt the jaundice, and worms in children.

Remedies for worms. 498. The diſtill'd water of the huſks of walnuts, is a very good vehicle in ſeveral diſeaſes; particularly in the jaundice: 'tis a cordial, and exceeding proper to be mixt with juleps in fevers. 'Tis, alſo, an excellent medicine againſt the worms, eſpecially for children.

An approved medicine againſt the worms in children.

499. Infuſe one dram of clean quick-ſilver all night, in about two ounces of the ſtill'd water of goats-rue; afterwards ſtrain and filter it. This quantity is to be given for one doſe.

An experienced ointment for the worms in children.

500. Take rue, wormwood, and ſavin, of each a ſufficient quantity; and with *May* butter, or freſh hogs-lard, boil the herbs ſoftly, till you have brought the mixture to be very green. Then ſtrain it, and put it up for uſe; when you employ it, firſt anoint with it the pit of the ſtomach, and part of the cheſt; and after a while rub it pretty well upon, and all about the navel.

A powerful remedy for freſh wounds.

For wounds. 501. With the juice of celandine, dreſs recent wounds and cuts, inſtead of a balſam.

A balſam to ſtench the blood of freſh wounds, and to heal them ſpeedily.

502. Take good *Venice* turpentine, and in a limbec diſtil off a large part of it with a very moderate fire, till there remains a thick ſubſtance, of a liquid and balſamic conſiſtence; which is the ſubſtance we ſeek for, and ſhould be apply'd as a balſam.

An excellent wound-drink.

503. Take harts-tongue, liver-wort, wood-bugle, wood-ſage, wood-betony, ſouthernwood, wormwood, alehoof, bugloſs, ſcabious, ribwort, white-bottles, mugwort, comfrey, mint, agrimony, ſtrawberry and violet-leaves, cinquefoil, daiſie-leaves, roots, and flowers, wild honey-ſuckles, wild angelico, avens, plantain, clowns, wound-wort, hawthorn-buds, oak-buds, and bramble-buds.

Gather

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

AN HISTORICAL ACCOUNT OF A DEGRADATION OF GOLD,

Made by an

ANTI-ELIXIR:

A STRANGE CHYMICAL NARRATIVE.

By the HONOURABLE
ROBERT BOYLE, Esq;

The SECOND EDITION.

LONDON:
Printed for R. MONTAGU, at the *Book-Ware-House*, in *Great Wilde-Street*, near *Lincoln's-Inn Fields*.

MDCCXXXIX.

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ciently appear'd, that the insuing Conference was but a Continuation of a larger Discourse; *yet considering that this Part consists chiefly, not to say only, of a* Narrative, *which (if I may so speak) stands upon its own Legs, without any need of depending upon any thing that was deliver'd before, I thought it was no great Venture, nor Incongruity, to let it come Abroad by it self. And, I the less scrupled to make this Publication, because I found that the Honourable Mr.* Boyle *confesses himself to be fully Satisfied of the Truth of so much of the Matter of Fact, as delivers the* Phœnomena *of the Trial: The Truth whereof was farther confirm'd to me, by the Testimony, and particular Account, which that most Learned and Experienc'd* Physician, *who was Assistant to* Pyrophilus *in making the Experiment, and with whom*

whom I have the Honour to be acquainted (being now in London) *gave me with his own Mouth, of all the Circumstances of the Trial. And, where the Truth of this shall be once granted, there is little Cause to doubt, that the Novelty of the thing will sufficiently indear the Relation; especially to those who are studious of the* higher Arcana *in the* Hermetic Philosophy. *For most of the* Phœnomena *here mention'd will probably seem wholly new, not only to vulgar* Chymists, *but also to the greater part of the more knowing* Spagyrists, *and* Natural Philosophers *themselves: None of the* Orthodox *Authors, as far as I can remember, having taken Notice of such an* Anti-Elixir. *And, though* Pyrophilus's *Scrupulosity (which makes him very unwilling to speak the utmost of a thing) allows it to be a Deterioration into an Imper-*

Imperfect Metal only, yet, to tell the Truth, I think it was more imbas'd than ſo: For the Part left of it (and kept for ſome farther Diſcoveries) which I once got a Sight of, look'd more like a Mineral, *or* Marchaſite, *than any* Imperfect Metal: *and therefore this Degradation is not the ſame with, but much greater than, that which* Lullius *doth intimate in ſome Places. Theſe Conſiderations make me preſume it will eaſily be granted, That the Effects of his* Anti-Philoſopher's Stone, *as I think it may not unfitly be call'd, will not only ſeem very* ſtrange *to* Hermetic, *as well as other* Philoſophers, *but may prove very* inſtructive *to Speculative Wits; eſpecially if* Pyrophilus *ſhall pleaſe to acquaint them with that more odd* Phœnomenon, *which he mentions darkly in the Cloſe of his* Diſcourſe.

AN

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

" Change of other *Metals* into *Gold*, is not a Thing abſolutely
" impoſſible; and, though I confeſs, I cannot remove all
" your Doubts and Objections, or my own, by being able
" to affirm to you, That I have with my own Hands made
" a Projection, (as *Chymiſts* are wont to call the ſudden Tranſ-
" mutation made by a ſmall Quantity of their admirable
" *Elixir*) yet I can confirm much of what hath been argued
" for the Poſſibility of ſuch a ſudden Change of a Metalline
" Body, by a Way, which, I preſume, will ſurprize you:
" For, to make it more credible, that other Metals are
" capable of being graduated, or exalted into Gold *by way*
" *of Projection*, I will relate to you, that *by the like Way*,
" Gold has been degraded, or imbaſed.

The Novelty of this *Preamble* having much ſurpriſed the Auditory, at length, *Simplicius*, with a diſdainful Smile, told *Pyrophilus*: " That the Company would have much thanked
" him if he could have aſſured them, That he had ſeen ano-
" ther Metal exalted into Gold; but, that to find a Way of
" ſpoiling Gold, was not only an uſeleſs Diſcovery, but a
" prejudicial Practice.

Pyrophilus was going to make ſome Return to this *Animadverſion*, when he was prevented by *Ariſtander*; who, turning himſelf to *Simplicius*, told him, with a Countenance and Tone that argued ſome Diſpleaſure: " If *Pyrophilus* had been
" diſcourſing to a Company of Goldſmiths, or Merchants;
" your ſevere Reflection, upon what he ſaid, would have been
" proper: But, you might well have forborn it, if you had
" conſidered, as I ſuppoſe he did, that he was ſpeaking to an
" Aſſembly of *Philoſophers* and *Virtuoſi*, who are wont to eſti-
" mate Experiments, not as they inrich Mens Purſes, but their
" Brains; and think Knowledge eſpecially of uncommon
" Things very deſirable, even when it is not accompanyed
" with any other Thing than the Light that ſtill attends it,
" and indears it. It hath been thought an uſeful Secret, by

" a kind of Retrogradation to turn Tin and Lead into brit-
" tle Bodies, like the Ores of thoſe Metals; and, if I thought
" it proper, I could ſhew, that ſuch a change might be of uſe
" in the Inveſtigation of the Nature of thoſe Metals, beſides
" the practical uſes that I know may be made of it. To find
" the Nature of Wine, we are aſſiſted, not only by the me-
" thods of obtaining from it a Spirit, but by the ways of
" readily turning it into Vinegar: the knowledge of which
" ways hath not been deſpiſed by Chymiſts or Phyſitians,
" and hath at *Paris*, and divers other places, ſet up a profi-
" table Trade. 'Tis well known that divers eminent *Spagy-*
" *riſts* have reckon'd amongſt their higheſt *Arcana* the ways
" by which they pretended, (and I fear did but pretend) to
" extract the Mercury of Gold, and conſequently *deſtroy*
" that Metal; and 'twere not hard to ſhew by particular in-
" ſtances, that all the Experiments, wherein Bodies are in
" ſome reſpects deteriorated, are not without diſtinction to
" be rejected or deſpis'd: ſince, in ſome of them, the Light
" they afford may more than countervail the Degrada-
" tion of a ſmall quantity of matter, though it be Gold it
" ſelf. And indeed, (continues he) if we will conſider
" things as Philoſophers, and look upon them as Nature
" hath made them, not as Opinion hath diſguiſed them, the
" prerogatives and uſefulneſs of Gold, in compariſon of
" other Metals, is nothing near ſo great as Alchymiſts and
" Uſurers imagine. For, as it is true that Gold is more
" ponderous and more fix'd, and perhaps more difficult to
" be ſpoiled, than Iron, yet the qualities (whereof the
" firſt makes it burthenſom, and the two others ſerve chiefly
" but to diſtinguiſh the true from counterfeit) are ſo balan-
" ced by the hardneſs, ſtiffneſs, ſpringineſs, and other uſe-
" ful qualities of Iron, that if thoſe two Metals I ſpeak of
" (Gold and Iron) were equally plentiful in the World, it
" is ſcarce to be doubted but that Men would prefer the

" more uſeful before the more ſplendid; conſidering how
" much worſe it were for Mankind to want Hatchets, and
" Knives and Swords, than Coin and Plate. Wherefore,
" (concludes he) I think *Pyrophilus* ought to be both deſi-
" red and incouraged to go on with his intended Diſcourſe,
" ſince, whether Gold be or not be the beſt of Metals, an aſſu-
" rance that it may be degraded may prove a Novelty very
" inſtructive, and perhaps more ſo than the Tranſmutation
" of a baſer Metal into a Nobler. For I remember it hath
" long paſs'd for a Maxim among Chymical Philoſophers,
" That, *Facilius eſt aurum conſtruere quam deſtruere*; and,
" whatever becomes of that, 'tis certain that Gold being
" the cloſeſt, the conſtanteſt, and the leaſt deſtructible of
" Metals, to be able to work a notable and almoſt *eſſential*
" *change* in ſuch a Body, (though, by detereorating it) is
" more than to work a *like change*, (though in popular eſti-
" mation for the better) in any Metal leſs indiſpoſed to ad-
" mit alterations, eſpecially in ſuch an one as *Pyrophilus* inti-
" mates, by telling us that, 'twas made by *Way of Projection*,
" and conſequently by a very ſmall portion of active mat-
" ter: whereas the deſtructions that Vulgar Chymiſts pre-
" tend to make of Gold, are wont to be attempted to be
" made by conſiderable portions of Corroſive *Menſtruums*;
" or other fretting Bodies; and even theſe, Experience
" ſhews to be uſually too weak to *ruin*, though ſometime
" they may much *diſguiſe*, the moſt ſtable Texture of
" Gold. *Cuncta adeo miris illic complexibus hærent.*

Pyrophilus perceiving by ſeveral ſigns that he needed not add any thing of apologetical to what *Ariſtander* had already ſaid for him, reſumed his Diſcourſe, by ſaying: " I was go-
" ing, Gentlemen, when *Simplicius* diverted me, to tell you,
" That looking upon the vulgar Objections that have been
" wont to be fram'd, againſt the poſſibility of metalline
" Tranſmutations from the Authority and Prejudices of
" *Ariſtotle*,

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" who treat of these *Arcana* confess that not every mat-
" ter, which may be justly called the Philosophers Stone,
" is able to transmute other Metals in vast quantities;
" since several of these Writers, (and even *Lully* himself)
" make differing *orders* or *degrees* of the *Elixir*, and ac-
" knowledge, that a Medicine or Tincture of the first or
" *lowest* order will not transmute above ten times its weight
" of an inferior Metal.

Pyrophilus having at this part of his Discourse made a short pause to take breath, *Cratippus* took occasion from his silence to say to him: " I presume, *Pyrophilus*, I shall be gain-
" sayed by very few of these Gentlemen if I tell you,
" that the company is impatient to hear the Narrative of
" your Experiment; and, that if it do so much as probably
" make out the particulars you have been mentioning, you
" will in great likelihood *persuade most* of them, and will
" certainly *oblige* them *all*. I shall therefore, on their behalf
" as well as my own, sollicite you to hasten to the histori-
" cal part of a Discourse that is so likely to gratifie our Cu-
" riosity.

The Company having by their unanimous silence, testified their approbation of what *Crattippus* had said; and appearing more than ordinarily attentive, *Pyrophilus* proceeded as follows:

Being one day abroad, to return visits to my Friends, I was by a happy Providence (for it was beside my first Intention) directed to make one to an ingenious Foreigner, with whom a few which I had received from him had given me some little acquaintance.

Whilst this Gentleman and I were discoursing together of several matters, there came in to visit him a stranger, whom I had seen but once before; and though this was in a promiscuous company, yet he addressed himself to me in a way that quickly satisfied me of the greatness of his Civility, as he soon after did of the greatness of his Curiosity.

ſity. For the *Virtuoſo*, in whoſe Lodgings we met, having (to gratifie me) put him upon the diſcourſe of his Voyages; the curious ſtranger entertained us an hour or two with pertinent and judicious Anſwers to the Queſtions I askt him about places ſo remote, or ſo much within Land, that I had not met with any of our Engliſh Navigators or Travellers who had penetrated ſo far as to viſit them. And becauſe I found by his diſcourſe that I was likely to enjoy ſuch good company but a very little while, (ſince he told me that he came the other day into *England* only to diſpatch a buſineſs which he had already done as far as he could do it, and that afterwards he was with ſpeed to return, as, to my trouble, he did to his Patron who ſent him) I made the more haſte to propoſe ſuch Queſtions to him, as I moſt deſired to be ſatisfied about: and among other things, enquiring whether in the Eaſtern parts he had travers'd, he had met with any Chymiſts, he anſwered me that he had; and that though they were *fewer*, and more *reſerved* than ours, yet he did not find them at all leſs *skilful*. And on this occaſion, before he left the Town to go aboard the Ship he was to overtake, he in a very obliging way put into my hands at parting a little piece of Paper, folded up; which he ſaid contained all that he had left of a rarity he had received from an Eaſtern *Virtuoſo*, and which he intimated would give me occaſion both to remember him, and to exerciſe my thoughts in uncommon Speculations.

The great delight I took in converſing with a Perſon who had travelled ſo far, and could give me ſo good an account of what he had ſeen, made me ſo much reſent the being ſo ſoon deprived of it, that though I judg'd ſuch a *Vertuoſo* would not, as a great token of his kindneſs, have preſented me a trifle, yet the Preſent did but very imperfectly conſole me for the loſs of ſo pleaſing and inſtructive a Converſation.

Never

Nevertheleſs, that I might comply with the curioſity he himſelf had excited in me, and know how much I was his Debtor, I reſolved to ſee what it was he had given me, and try whether I could make it do what I thought he *intimated*, by the help of thoſe few *hints*, rather than *directions*, how to uſe it, which the parting haſte he was in (or perhaps ſome other reaſon beſt known to himſelf) confin'd him to give me. But in regard that I could not but think the Experiment would one way or other prove extraordinary, I thought fit to take a Witneſs or two and an Aſſiſtant in the trying of it; and for that purpoſe made choice of an experienced Doctor of Phyſick, very well vers'd in the ſeparating and coppelling of Metals.

Though, the Company (ſays *Heliodorus*) be ſo confident of your ſincerity and warineſs, that they would give credit even to unlikely Experiments, upon your ſingle teſtimony, yet we cannot but approve your diſcretion in taking an Aſſiſtant and a Witneſs; becauſe in nice and uncommon Experiments we can ſcarce uſe too much circumſpection, eſpecially when we have not the means of reiterating the trial: for, in ſuch new as well as difficult caſes, 'tis eaſy even for a clear-ſighted Experimenter to over-look ſome important circumſtance, that a far leſs skilful by-ſtander may take notice of.

As I have ever judged, ſayed *Pyrophilus*, that cautiouſneſs is a very requiſite qualification for him who would ſatisfactorily make curious Experiments, ſo I thought fit to imploy a more than ordinary meaſure of it in making a trial whoſe event I imagined might prove odd enough. And therefore, having ſeveral times obſerved that ſome men are prepoſſeſſed by having a particular Expectation rais'd in them, and are inclined to think they really *do ſee* that happen which they think they *ſhould* ſee happen; I reſolved to obviate this prejudication as much as innocently I could,

and

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out the help of Borax, or any other Additament, (which courſe, though ſomewhat more laborious, than the moſt uſual one we took to obviate ſcruples) I put into the well-melted Metal with my own hand the little parcel of Powder lately mentioned; and continuing the Veſſel in the fire for about a quarter of an hour, that the Powder might have time to difuſe it ſelf every way into the Metal, we poured out the well-melted Gold into another Crucible which I had brought with me, and which had been gradually heated before to prevent cracking. But though, from the firſt fuſion of the Metal to the pouring out, it had turn'd in the Crucible like ordinary Gold, ſaving that once my Aſſiſtant told me he obſerved that for two or three moments it looked almoſt like an Opal, yet I was ſomewhat ſurpriz'd to find when the matter was grown cold, that though it appear'd upon the Balance that we had not loſt any thing of the weight we put in, yet in ſtead of *fine Gold* we had a lump of Metal of a dirty colour, and as it were overcaſt with a thin coat, almoſt like *half vitrified Litharge*. And ſomewhat to increaſe the wonder, we perceived that there ſtuck to one ſide of the Crucible a little Globule of Metal which looked not at all yellowiſh but like courſe Silver, and the bottom of the Crucible was overlaid with a vitrified ſubſtance, whereof one part was of a tranſparent yellow, and the other of a deep brown inclining to red: and in this vitrified ſubſtance I could plainly percieve ſticking at leaſt five or ſix little Globules that looked more like impure Silver than pure Gold. In ſhort, this *ſtuff* looked ſo little like *refin'd*, or ſo much as *ordinary*, *Gold*, that though my Friend did much more than I marvel at this change, yet I confeſs I was ſurpriz'd at it my ſelf; for though in ſome particulars it anſwered what I looked for, yet in others it was very different from that which the Donor of the Powder had, as I thought, given me ground to expect: Whether the cauſe of my diſappointment

pointment were that (as I formerly intimated) this *Virtuoso's* haſte or deſign made him leave me in the dark; or whether it were that, finding my ſelf in want of ſufficient directions, I happily pitched upon ſuch a proportion of Materials, and way of operating, as were proper to make a new Diſcovery, which the excellent Giver of the Powder had not Deſign'd or perhaps thought of.

I ſhall not at all wonder, ſayed *Cratippus*, either at your Friends amazement or at your ſurprize, if your farther trials did in any meaſure confirm what the *ſuperficial change* that appeared in your Metal could not but incline you to conjecture.

You will beſt judge of that (replied *Pyrophilus*) by the account I was going to give you of what we did with our odd Metal: *And Firſt*, having rubb'd it upon a good Touchſtone, whereon we had likewiſe rubb'd a piece of *Coin'd Silver* and a piece of *Coin'd Gold*, we manifeſtly found that the mark left upon the Stone by our Maſs between the marks of the two other Metals, was notoriouſly more like the Touch of the Silver than that of the Gold; *Next*, having knocked our little lump with a Hammer, it was, (according to my prediction) found brittle, and flew into ſeveral pieces; *Thirdly*, (which is more) even the inſides of thoſe pieces looked of a baſe dirty colour, like that of Braſs or worſe: for the *fragments* had a far greater reſemblance to *Bell-Metal*, than either to Gold or to Silver. To which we added this *fourth*, and more conſiderable, Examen; that having carefully weigh'd out one dram of our ſtuff, (reſerving the reſt for trials to be ſuggeſted by *ſecond thoughts*) and put it upon an excellent new and well-neal'd Coppel, with about half a dozen times its weight of Lead, we found, ſomewhat to our wonder, that though it turn'd very well like good Gold, yet it continued in the fire above an hour and an half, (which was twice as long as we expected) and

almoſt to the very laſt the fumes copiouſly aſcended, which ſufficiently argu'd the operation to have been well carried on; and when at length it was quite ended, we found the Coppel very ſmooth and intire, but ting'd with a fine purpliſh red, which did ſomewhat ſurprize us: likewiſe, beſides the *refined Gold*, there lay upon the cavity of the Coppel ſome dark-coloured recrements, which we concluded to have proceeded from the deteriorated Metal, not from the Lead. But when we came to put our Gold again into the Ballance, we found it to weigh only about *fifty three Grains*, and conſequently to have loſt *ſeven*; which yet we found to be fully made up by that little quantity of recrements I have lately mentioned, whoſe Weight and Fixity, compared with their unpromiſing Colour, did not a little puzzle us; eſpecially becauſe we had not enough, either of them or of leiſure, to examine their nature. To all which circumſtances I ſhall ſubjoin this, that, to prevent any ſcruples that might ariſe touching the *Gold* we imploy'd, I cauſed a dram and a half (which had been purpoſely reſerv'd out of the ſame portion with that which had been debaſed) to be in my Aſſiſtants preſence melted by it ſelf, and found it (as I doubted not but I ſhould do) fine and well-coloured Gold.

I hope you will pardon my curioſity, ſayed *Ariſtander* to the Gentleman who ſpoke laſt, if I ask why you take no notice of the effect of *Aqua fortis* upon your *imbaſed Metal*? Your Queſtion, replies *Pyrophilus*, I confeſs to be very reaſonable, and I am ſomewhat troubled that I can't anſwer it but by telling you that we had not at hand any *Aqua fortis*, we durſt relie on; which yet I was the leſs troubled at, becauſe heretofore ſome *trials* purpoſely made had inform'd me, that in ſome *metalline Mixtures* the *Gold*, if it were much predominant in quantity, may protect another Metal (for inſtance *Silver*) from being *diſſolved* by that *Menſtruum*, though not from being at all *invaded* by it.

There-

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not, ſtay for an expreſs order from the Company to give you their hearty thanks: for as the *obliging Stranger* did very much gratifie *you* by the Preſent of his *Wonderful Powder*, ſo you have not a little gratified *us* by ſo *candid* and *particular* a Narrative of the effects of it; and I hope (continues he) that if you have not yet otherwiſe diſpos'd of that part of your *deteriorated Gold* which you did not coppel, you will ſometime or other favour us with a ſight of it.

I join in this requeſt ſayed *Cratippus*, as ſoon as he perceived the Preſident had done ſpeaking, and, to facilitate the grant of it, I ſhall not ſcruple to tell *Pyrophilus* he may be confident that the *Degradation* of his *Gold* will not *depreciate* it amongſt Us: ſince, if it be allowable for Opinion to ſtamp ſuch a value upon *old Coins* and *Medals*, that, in the Judgment of good Antiquaries, a ruſty piece of *Braſs* or *Copper*, with a half defaced Image or Inſcription on it, is to be highlier valued than as big a piece of well-ſtampt *Gold*, I ſee not why it ſhould not be lawful for Philoſophers to prize ſuch a lump of *depraved Gold* as yours, before the *fineſt Gold* the Chymiſts or Mintmaſters are wont to afford us. And though I freely grant that ſome old *Copper Medals* are of good uſe in Hiſtory, to keep alive by their *Inſcriptions* the memory of the taking of a Town, or the winning of a Battel, though theſe be but things that almoſt every day are ſome where or other done, yet I think *Pyrophilus*'s imbas'd Metal is much to be preferr'd; as not only *preſerving* the *memory*, but *being an effect* of *ſuch* a Victory of Art over Nature, and the conquering of ſuch generally believ'd inſuperable difficulties, *as* no Story that I know of gives us an example of.

As ſoon as ever *Cratippus* had made a pauſe, *Pyrophilus*, to prevent complimental diſcourſe, did in a few words tell the Preſident: That his part had been but that of a Relator of matter of Fact, and that therefore he could deſerve but

little

little thanks and *no praiſe* at all; though a good meaſure of both of them were due to the *obliging Virtuoſo* who had given him the Powder, and thereby, the opportunity of complying with his duty, and his inclination, to ſerve that learned Company.

Theſe Gentlemen (ſayed *Ariſtander*) are not perſons among whom modeſty is either *reſtrained* from expreſſing it ſelf, or *conſtrued* according to the Letter; and therefore whatever you have been pleas'd to ſay, the Company cannot but think itſelf much obliged to you: Beſides I know the obligation would be much increas'd, if you would favor us with your reflections upon the extraordinary Experiment you have been pleaſed to relate to us.

If, replies *Pyrophilus*, I had had wherewithal to repeat the Experiment, and vary it according to the hints afforded me by the firſt trial, I ſhould be leſs unfit to comply with *Ariſtander*'s motion: but the *Phœnomena* are too new and too difficult for me to attempt to unriddle them by the help of ſo ſlender an *information* as a perſon, ſo little ſagatious as I, could get by a *ſingle trial*; and though I will not deny that I have had ſome raving thoughts about this puzzling ſubject, yet I hope I ſhall eaſily be pardon'd, if I decline to preſent crude and *immature* thoughts to a Company who ſo well *deſerve* the moſt *ripe* ones, and can ſo skilfully *diſcover* thoſe that are not ſo.

I confeſs, ſayed *Heliodorus*, that I think *Pyrophilus*'s warineſs deſerves, not only to be *allow'd*, but *imitated*; and therefore by my conſent the farther diſcourſe on ſo abſtruſe a ſubject ſhall be deferr'd till we ſhall have had time to conſider ſeriouſly of *Phœnomena* that will be ſure to *imploy* our moſt ſpeculative thoughts, and I fear to *poſe* them too: only we muſt not forget that *Pyrophilus himſelf* ought to be, not barely *allow'd* but, *invited* to draw before we riſe, ſuch Corrollaries as he thinks fit to propoſe from what he hath already delivered.

The

The inference, ſayed *Pyrophilus*, I meant to make, will not detain you long, having for the main been already intimated in what, you may remember I told you, I deſign'd in the mention I was about to make of the now-recited Experiment. For, without launching into difficult Speculations or making uſe of diſputable Hypotheſes, it ſeems evident enough, from the matter of Fact faithfully laid before you, that an Operation *very near*, if not *altogether*, as ſtrange as that which is call'd Projection, and in the difficulteſt points much of the ſame nature with it, may ſafely be admitted. For our Experiment plainly ſhews that Gold, though confeſſedly the moſt homogeneous, and the leaſt mutable of Metals, may be in a very ſhort time (perhaps not amounting to many minutes) exceedingly *chang'd*, both as to *malleableneſs*, *colour*, *homogeniety*, and (which is more) *ſpecifick Gravity*; and all this by ſo very inconſiderable a Portion of injected Powder, that, ſince the Gold which was wrought on weighed two of our Engliſh drams and conſequently an hundred and twenty grains, an eaſie computation will aſſure us that the Medicine did thus powerfully act, according to my eſtimate, (which was the modeſteſt) upon near a thouſand times, (for 'twas above nine hundred and fifty) its weight of Gold, and according to my Aſſiſtants eſtimate, did (as they ſpeak) *go near* upon twelve hundred. So that if it were fit to apply to this *Anti-Elixir*, (as I formerly ventur'd to call it) what is ſayed of the true *Elixir* by divers of the Chymical Philoſophers, who will have the virtue of their Stone increas'd in ſuch a proportion, as that at firſt 'twill tranſmute but *ten* times its weight, after the next rotation *an hundred* times, and after the next to that *a thouſand*, our Powder may in their language be ſtil'd *a Medicine of the third order*.

The Computation, ſayed *Ariſtander*, is very obvious, but the change of ſo great a Portion of Metal is ſo wonderful and unexampled, that I hope we ſhall among other things

learn

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

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Tranſ-

DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

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DELVE INTO FANTASY, MAGIC, MYTHOLOGY & FOLKLORE

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