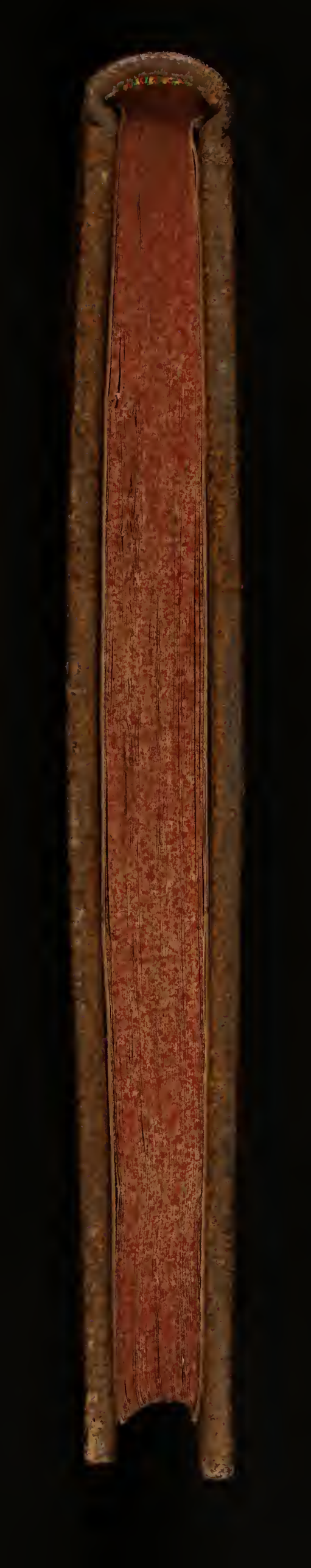
BATHES AND WATERS. — E. JORDEN.

1632



VI 3

A Discourse of Naturall

BATHES,

And Minerall

WATERS.

Wherein first the originall of Fountaines in generall, is declared.

Then the nature and differences of Minerals, with examples of particular Bathes from most of them.

Next the generation of Minerals in the earth, from whence both the actuall heat of Bathes, and their vertues are proued to proceed.

Also by what meanes Minerall Waters are to bee examined and discouered.

And lastly, of the nature and vses of Bathes, but especially of our Bathes at BATHE in Sommerset-shire.

The second Edition in many points enlarged.

By ED. IORDEN, D^r. *in Physick.*

LONDON,
Printed by THOMAS HARPER. 1632.

TO THE RIGHT HONORABLE, FRANCIS Lord COTTINGTON, Baron of *Hanworth*, Chancellour of the Exchequer, and one of his Maiesties most honorable Priuy Councell.

THE profitable vse of Bathes, both for necessity and comfort, is such, and so well confirmed from all antiquity, as I need not labour to illustrate it more; only it hath beene the ill hap of our Country Bathes to ly more obscure then any other throughout Christendome, although they deserue as well as the best, because very few haue written any thing of them, and they haue either not mentioned, or but slightly passed ouer the maine points concerning their causes and originals; contenting themselues with an empiricall vse of them. This hath made me, through the instigation also of some of my worthy friends, to attempt somewhat in this kinde: which if it giue not satisfaction according to my desire, yet it may be a prouocation to some others, to

perfect that which I haue begun. And seeing I doe it for the vse of my Country, I haue neglected curious ornaments to garnish it withall, but haue clad it in a plaine suit of our Country-Cloath; without welt or gard : not desiring it should shew it selfe in forrain parts : *Mea cymba legat littus.*

But in this mine vndertaking, I finde my selfe exposed to many censures, both concerning some paradoxicall opinions in Philosophy, which notwithstanding I deliuer not *gratis*, but confirmed with good grounds of reason and authorities: as also concerning the reformation of our Bathes, which doe daily suffer many indignities more wayes then I haue mentioned, vnder the tyranny of ignorance, impostures, priuate respects, wants, factions, disorder, &c. so as they are not able to display their vertues, and doe that good for which God hath sent them to vs : and all for want of such good gouernment as other Bathes do enioy. I blame not our City herein, vnto whose care the ordering of these Bathes is committed, the disorders and defects being such as are out of their verge, and neither in their power, nor in their knowledge to redresse. For they haue sufficiently testified their

desire

desire of reforming all such abuses, when they voluntarily did ioyne in petitioning the late King *Iames* of blessed memory, to that end: by whose death this petition also died. And they knew well that it must be superior power that must effect it. In these respects I haue need of some noble and eminent Patron to protect both mee and my Bathes, whose cause I take vpon me to plead, and to aduance, according to their due desert: but especially for the Bathes sake, which I desire may florish to the vtmost extent of benefit to the people; and to haue all impediments remoued out of their way, which may hinder them in the progresse of their vertues. This is the cause, Sir, why I presume to dedicate these my labours to your Honour, who hauing obserued in forraine parts, the vses and gouernments of all sorts, and being both by the fauour of his Maiesty well able, and by your noble disposition well inclined and willing to maintaine good order and discipline, will, I doubt not, excuse this boldnesse, and pardon my presumption. Consider, Sir, that this is your natiue Country, which naturally euery man doth affect to aduance, and these Bathes are the principall Iewels of your Country, & able to make it more famous

then any other parts of this Kingdome, and in aduancing them, to aduance your name to all posterity. Wherefore howsoeuer my selfe deserue but small respect from you, yet I beseech you respect the Bathes of your Country, and me as a welwisher vnto them.

And as the common opinion of your great worth and abilities, haue moued mee to this boldnesse, so the particular fauors of your Noble Lady, and the encouragement of your learned Physitian, Master, Doctor *Baskeruill*, mine especiall friend, who hath spurred mee on to this work, haue remoued out of my minde all suspition of misconstruction. But that as mine intent hath beene meerely the enlarging of the knowledge of those points concerning Bathes, and more especially of our Bathes in Sommersetshire; so you will bee pleased to accept of this publique inuitation by mee to doe your Country good, and your selfe honor, which I wish may neuer be disioyned. And to mee it will bee no small encouragement to deuote my selfe and my best endeauours to your seruice. So I humbly take my leaue this 23. *Aprilis*, 1632.

Your Lordships most humble seruant,

ED. IORDEN.

Libellum istum DE AQVIS MEDICATIS *à Doctissimo* IORDANO *antiquissimo Collega nostro scriptum multiplici eruditione & novarum subtilitatum varia supellectile refertissimum, legimus, & qui ab omnibus tam Philosophis quam Medicis legatur dignissimum iudicavimus.*

IOHANNES ARGENT *Collegij Medicorum Londinensium Præsidens.*

IOHANNES GIFFORD.

SIMON BASKERVILLE.

THOMAS RIDGELEY.

In

In laudem operis.

Parve alacri passu liber, Liber, ibis in orbem;
Dentesque spernes lividos.
Authores pandit, sua dat, Iordanus, & usu
Quæsita multo protulit.
Aëra qui totus, flammas meditatur, & undas,
Terram, metalla discutit.
Quicquid in his veteres, docuit quicquid Novus Author,
Celeri notavit pollice.
At sua dum exponit, lucem dat, operta recludit,
Pennâque fertur liberâ.
Perge liber; gratus gratum volveris in ævum,
Lymphæ calentes dum fluent.

Ed. Lapworth, M.D.

In laudem Authoris:

Numine divino Iordan *medicabile flumen*
Dicitur, è gelido licèt illud frigore constet:
Tu Iordane *decus Medicorum, candide Doctor,*
Lumine divino gnarus discernere causas
Ægris corporibus nôsti depellere morbos;
Intima secluſæ penetrâsti viscera terræ,
Thermarum vires aperis, reseraſque metalla:
De gremio telluris aquas manare calentes
Qua ratione doces, nobis priùs abdita pandis
Scrutando Physices arcana indagine mira,
Nec caperis famâ, nec inani laudis amore,
Vt patriæ prosis, dignaris promere lucem:
Qui memoraverunt, vel qui modò Balnea tractant,
Non sunt te meliùs meriti, vel iudice Momo.

Io. Dauntsey.

Ad Authorem.

SI fælix rerum potuit qui noſcere cauſas,
Inter fælices tu prope primus eris.
Sunt quæcunq; tulit vel terra, vel unda, vel aër,
Singula nota tibi, ſingula certa tibi.
Omnigenæ tibi vena reperta, reſecta metalli,
Nullaq; te in quovis corpore vena latet.
Non tu nominibus veterum terreris, ut umbris,
Nec tibi, ceu multis, quæ nova ſola placent.
Et doctâ & iuſtâ rationis ſingula lance
Libras, quæ veteres quæq; tulêre novi.
Nec cauſas tantum ſcrutans tu negligis uſum:
Vtilis eſt libri pagina quæque tui.
Hoc unum doleo, quod non ſint Anglica noſtra
Balnea, per calamum facta Latina tuum:
Vt reſceret ut gentis per te ſic gloria noſtræ
In longos celebris per loca cuncta dies.

COme hither Reader, bathe thy tender eyes
In *Iordans* ſtreames which out of *Bathe* do riſe,
hey'l cleare thy ſight, and make thee cleerly ſee
hoice ſecrets, which in earths deep boſome be
loſely laid vp, and choicely ſecret kept,
/here vnobſerv'd they many ages ſlept.
ere come and bathe in *Iordans* ſtreames thy minde,
hou there a ſtrange yet certaine cure ſhalt finde
f old ore-ſpreading errors leproſie,
/hich theſe cleare ſtreames do ſweetly mundifie:
ere are two miracles of nature met,
ere are two miracles of *England* ſet;

Our Engliſh Bathes, our Engliſh *Iordans* ſtreames
Are gathered here as natures choyceſt creames,
Produc'd by her, by learned Art refin'd
For th' vniuerſall good of humane kinde.
May much good hence be rayſ'd, and may it rayſ
As well firſt Authors as Inuentors praiſe.

Nicol. Stoughton, of Stoughton, Eſqui

Bis duas gaudes numerare cauſas
(Nam tot authores varij dederunt)
Vnde Thermarum calor ortum haberet
(candide Doctor.)
Tu tenax, nullâ, tamen acquieſcis
Ex ijs cauſis: mihi dic (amice)
Cur tibi ſoli via ſingularis
perplacet iſta?
Arrogans forſan nimis ipſe multis
Qui viam linquis, videare, tritam:
Zoili & nigro vocitere vanus
ore Philautus.
Sed cui candor tuus innoteſcit,
Qui tuos mores benè novit; is te
Litis oſorem vocet, & ſerenæ
pacis amantem.
Sint licet Plato Socrateſq; amici,
Tu licet doctos verearis omnes,
Veritas maior tamen eſt amica,
quæ tibi cordi eſt.

Rob. Pierce Bach. in Theologia.

OF NATVRALL BATHES, AND MINERALL WATERS.

Cap. 1.

Explication of the word Bathe. The scope and argument of this Booke. The ancient vse and esteeme of Bathes among the Romans. The moderne vse of them among the Turkes. Of medicinable Bathes, and minerall Waters. How esteemed by Greekes, Latines, Arabians, & other nations.

THE word *Bathe* or *Balneum* is of larger extent then I purpose to discourse of: for it being the name of a forme of remedie applied to the body, it may be framed either out of liquid things, or solid substances, or vapours.

Liquid Substances are Water, Milke, Must, Wine, Oyle:

Oyle: ſollid ſubſtances are Sand, Salt, preſſed Grapes, Corne, &c. vapours are Stuffes and hot houſes.

My intent is onely to treate of waters, and principally of thoſe which be called Minerall, whether they bee vſed in Bath or in Potion, &c.

Theſe kinde of watry and vaporous Bathes haue been in vſe from all antiquity, and held in great eſteeme, both for pleaſure, and for preſeruation of health. For there is no forme of remedy more comfortable to mans body, or which eaſeth paine and wearineſſe more ſpeedily, and more effectually. And whereas *Hyppocrates* commends thoſe remedies which doe cure *citò, tutò, & iucundè*, ſpeedily, ſafely, and with comfort; theſe Bathes performe all theſe intentions: and beſides, may be vſed to all ſexes and ages, and temperatures, without hurt or inconuenience, inſomuch as the ancient Romans had them in very frequent vſe: their diet being liberall, and vpon variety of meates, eſpecially vpon Lettice, Coleworts, Aſparagus, raw fruits, and ſuch like, which bred crude humours in their bodies, and had need of ſome ſuch helpe to digeſt them: as *Columella* ſaith, *quotidianam cruditatem laconicis excoquimus*: we concoct our crudities by the vſe of Bathes. We reade in *Plynie*, that *Agrippa* built in *Rome* 170. publike Bathes for common vſe, and *Pancirollus* tels vs of 856. in *Rome* at one time, and all of them moſt ſumptuous and magnificent buildings, eſpecially the *Anthonin* and *Dioclesian* Bathes: the walles whereof were of admirable height, with an infinite number of marble Pillars, erected for oſtentation, and not to ſupport any thing, 1000. Seates to ſit in; Their *Caldaria*, *Tepidaria*, *Frigidaria*, moſt ſumptuous and ſtately: the whole fabricke ſo large and ſpacious, as they reſembled rather Cities then Houſes: And ſo it might well be, when as there were imployed

De deperditis pag. 164.

for

for the building of the *Diocleſian* Bathes, as *Baccius* ſaith. 40000. men, but *Salmuth* ſaith, 140000. for ſome yeares together. They were placed where now the Church of Saint *Angelo* ſtands. The Turkes at this day retaine that ancient cuſtome of the Romans, and are in nothing more profuſe, then in their Temples and Bathes, which are like vnto great Pallaces, and in euery Citie very frequent. And yet both the Romans and the Turkes vſed thoſe Bathes chiefly for pleaſure, and delicacy, and cleanlineſſe: the Romans going barelegged, and their waies duſty, had need of often waſhing: and the Turkes lying in their cloathes, ſubiect to Lice and wormes, if it were not for their often bathing.

Bellonius obſeruat. lib. 3 cap. 34. Proſper Alpinus de medicina Ægyptiorum.

Moreouer, the dyet of the Turkes, though it be more ſparing then that of the Romans, yet it is little better: namely, vpon hearbs, roots, raw fruit, &c. and their drinke, for the moſt part, water, being prohibited the vſe of wine by their Religion, muſt needs breede many crudities in their bodies, yet by their often bathings, they doe not onely ouercome them, but get a good habit of body, their women being accounted as delicate creatures as any in the world, who duely twiſe a weeke reſort to the Bathes.

Now if thoſe Nations would beſtow ſo much vpon their Bathes of delicacie and pleaſure, which were onely of pure water; wee haue much more reaſon to adorne our minerall Bathes; which (beſides the former vſes) are alſo medicinall and very ſoueraigne for many diſeaſes, conſiſting of wholeſome minerals, and approued for many hundred yeeres, of many who could not otherwiſe be recouered. At the leaſt wiſe if wee doe not beautifie and adorne them, yet we ſhould ſo accommodate them, as they might ſerue for the vtmoſt extent of benefit to ſuch as neede them.

For there is nothing in our profession of Physicke more vsefull, nor in the workes of nature more admirable, (man onely excepted, which *Plato* cals the great miracle) then naturall Bathes, and minerall Waters. The nature and causes whereof haue beene so hard to discouer, as our ancient Authors haue written little of them, holding them to be sacred or holy, either for that they iudged them to haue their vertue immediately from God, or at least from the celestiall Bodies; from whence, both their actuall heate was thought to be kindled, by lightnings or such like impressions, and other admirable vertues, and sometimes contrary effects deriued, which appeare in them. Also diuers miracles haue beene ascribed vnto those naturall Bathes, to confirme the opinion of a supernaturall power in them, as *Guaynerius* reports of the Bathes of *Aque* in *Italy*: and *Langius* out of *Athenæus*, concerning the Bathes of *Edepsus*, which both lost their vertue for a time. The one by the Magistrates prohibiting poore diseased people to vse them, the other by imposing a taxation vpon them: but vpon the reformation of those abuses, were restored to their former vertues againe.

Cap. 2. Epist. 53. lib. 2.

I need not herein auerring the opinion of Diuinitie which was held to be in Bathes, make any mention of the Poole of *Bethesda*, written of by Saint *Iohn*, and *Nonnus* the Poet: nor of the riuer *Iordan*, which cured *Naaman* the *Assyrian* of his Leprosie, being indeede true miracles, and done by a supernaturall power: yet it is likely that those and such like examples bred in the mindes of men a reuerend and diuine opinion of all Bathes: especially where they saw such strange effects as they could not well reduce to naturall causes.

And this hath beene the cause that in old time these minerall fountaines haue beene consecrated vnto certaine

taine deities: as *Hamon* in *Lybia*, vnto *Iupiter*: *Thermopylæ*, vnto *Hercules*, by *Pallas*: among the *Troglodits*, another to the *Sun*, &c. And at this day we haue diuers Bathes which carry the names of Sunne, Moone, and Saints: and many Townes and Cities named from the Bathes in them: as *Thermæ* in *Macedonia* & *Sicily*, *Thermidea* in *Rhodes*, *Aquæ* in *Italy*, *Aquisgran* in *Germany*, *Baden* in *Heluetia*: and our ancient Citie of Bathe in Sommersetshire, in honour whereof I haue especially vndertaken this labour, and I perswade my selfe, that among the infinite number of Bathes and minerall waters which are in Europe, there are none of more vniuersall vse for curing of diseases, nor any more commodious for entertainement of sicke persons, then these are.

Besides this sacred conceit of Bathes, wherewith in ancient times, the mindes of men were possest, we may adde this, that the nature of Minerals was not so well discouered by them, as it hath beene since: and therefore wee finde very little written of this argument, either in *Aristotle* or *Hippocrates*, or in *Galen*, who wrote most copiously in all other points of Physicke, yet concerning this hath little, and neuer gaue any of these waters to drinke inwardly, although hee acknowledgeth that they were in vse: and for outward vses, held them all to be potentially hot.

De tuenda sanit. lib. 4. cap. 4.

After these Grecians, the ancient Latines and Arabians succeeded: *Pliny*, *Celsus*, *Seneca*, *Lucretius*, *Auicen*, *Rhasis*, *Seraphio*, *Auerrhoes*, in whom wee finde some small mention of naturall Bathes, and some vse of Salt and nitrous, and *Aluminous* waters, but nothing of worth towards the discouerie of the naturall causes of them. It is likely they did passe it ouer slightly, either by reason of the difficulty in searching out the causes of them, or that they iudged them meerely metaphysicall.

But in later times the nature and generation of Minerals (from whence the Bathes proceede, and from whence the whole doctrine of them both for their qualities, and differences, originals and vse, must bee deriued) being better looked into, and obseruations taken from such as daily labour in the bowels of the earth, for the search of Mines, or such as afterwards prepare them for our necessarie vses; we haue attained to better knowledge in this kinde, then the Ancients could haue, although in all new discoueries there will be defects for succeeding ages to supply, so it fals out in this: *Dies Diem docet: Alpham Beta corrigit.* And although *Agricola, Fallopius, Baccius, Matheſius, Solinander, Libauius,* &c. haue added much vnto that which was formerly known in this point, and reformed many errors and mistakings in former writers: yet they haue left many things imperfect, doubtfull, obscure, controuerted, and perhaps false, as may appeare in the discourse following. I doe reuerence all their worths, as from whom I haue learned many things, which else I could hardly haue attained vnto; and I acknowledge them to haue beene excellent instruments for the aduancement of learning: yet I hope it may bee as free for mee without imputation of arrogancie to publish my conceits herein, as it hath beene for them, or may be for any other: *Hanc veniam petimuſque damuſque viciſsim:* My end and studie is the common good, and the bettering of this knowledge: and if I shall bring any further light to increase that, I shall be glad: otherwise my intent being to search out the truth, and not to contradict others, it will or ought to be a sufficient protection for me, wherefore I come to discourse of Minerall waters.

Cap. 2.

Definition of Minerall waters. The nature whereof cannot be vnderstood, except first consideration be had concerning simple water. Of which in this Chapter are shewed the qualities and vse.

MInerall waters are such, as besides their owne simple nature, haue receiued and imbibed some other qualitie or substance from Subterraneall Mynes. I say, besides their owne nature, because they retaine still their liquidnesse and cold, and moysture, although for a time they may be actually hot from an externall impression of heate, which being gone, they returne to their former cold againe. I say imbibed, to distinguish them from confused waters: as earth may bee confused with water, but not imbibed, and will sinke to the bottome againe: whereas such things as are imbibed, are so mixed with the water, as it retaines them, and is vnited with it: being either Spirits, or dissoluble Iuyces, or tinctures; I say from Subterraneall mynes, to distinguish them from animal or vegetable substances, as infusions or decoctions of hearbs, flesh, &c. *Libauius de iudicio aquarum miner. cap. 1.*

Seeing then that the Basis of these Bathes or minerall fountaines, is water, we must first consider the nature of simple water, and from thence wee shall better iudge of Minerall Waters and their differences.

By simple water I doe not meane the Element of water, for that is no where to be found among mixt bodies, but I mean such water as is free from any heterogeneall admixture, which may alter either the touch or taste, or colour, or smell, or weight, or consistence, or any other qualitie, which may be discerned either by the senses, or by the effects. This water therefore must haue his proper *Bactius lib. 1. cap. 6. Solinander lib. 2. cap 1.*

per colour and taſte, without ſauour, or ſmell, thin, light, cold, and moyſt; if any of theſe properties be wanting, or any redownd, it is mixed and infected.

Solinander lib. 1. cap. 3.

Cold and moyſture doe abound in water. For cold appeares by this, that being heated by any externall cauſe, it ſoone returnes to his cold nature againe, when the cauſe of the heate is remoued. And whereas Ayre is held by the Stoicks to be moſt cold, and confirmed by *Seneca* and *Libanius*, yet the reaſon they giue for it, doth ſeeme to proue water to bee more cold, becauſe they make the matter of ayre to bee water, and to haue his coldneſſe from thence. But *Ariſtotle* holds the ayre to be hot from the efficient cauſe which rarefied it, being of more validitie to make it hot, then water (the materiall cauſe) to make it cold. *Galen* is of neither ſide, for he doth not iudge it to bee hot, neither doth hee euer pronounce it to be cold: but by reaſon of his tenuity, apt to be altered either by heat or cold.

Quæſt. nat. 2.
Libau. pyrotech. cap. 20.
Meteor 4.
De vſu partium lib. 8. cap 3.

I will not here vndertake to determine whether all be bred of water, or whether it bee not a diſtinct ſubſtance of it ſelfe, and onely receiueth watry vapours into it, being agreeable in cold, moyſture, tenuity, &c. with it, and ſo lets them ſeparate in raine: and ſo exonerate it ſelfe of theſe vapours, as alſo of dry exhalations by windes, thunder, &c. or whether ayre bee onely the *effluuium* of the inferiour globe, being within the orbe of his vertue: as all Dominion hath not onely a place of reſidence and Manſion, but alſo a verge and territory where it exerciſeth his authority and gouernement; ſo the inferiour globe of the earth, and water hath his dominion beyond his owne globe, as likewiſe may bee thought of all other globes of the Planets, &c. But theſe points are impertinent to my purpoſe. It is enough for me to ſhew what I iudge of the temperature of the ayre,

Damæus phiſ. Chriſt part 2. cap. 9.
Ariſtot 1. Meteor. cap. 4.

concerning

concerning heate or cold. And to mee it seemes most probable, that the ayre of it selfe should be cold, as may appeare by this, that it is onely heated by externall causes, which being remoued, the ayre returnes to his former coldnesse againe. So we see that within the Tropicks in *Zona torrida*, as long as the Sunne is within their Horizon, and beats the ayre with his perpendicular beames, it is exceeding hot, especially in the vallies, where the reflection is most: in so much as *Aristotle* held those parts of the world to be inhabitable, in regard of the extremity of heat. But after the Sunne is set, the ayre returnes to his naturall coldnesse, vntill the Sunne arise and heat it ageine. *Iosephus a Costa* vrgeth this argument against *Aristotle*, about the habitablenesse of the torrid Zone, that the dayes and nights being there equall, the presence of the Sunne in the day time may well heate the ayre, but his absence for twelue houres more in the night, reduceth the ayre to a better temper: and vpon this and diuers other arguments and experience, which cannot be denyed, concludes, that if there be any Paradice vpon earth, it is vnder or neare the equinoctiall. The like reason may be drawne from the coldnesse of mountaines, which being neere to the middle region of the ayre, and wanting that reflection of the beames of the Sunne, which is in the valleyes, are continually cold, and often couered with snow, which would not be if the ayre were hot. As for the conceit that the middle region is made cold by an Antiperistasis, the element of fire being aboue it, and the reflection of the beames of the Sunne beneath it, it is an idle conceit. For these heats on both sides would rather heat then coole the middle region by by their working vpon it. Also take away the element of fire from vnder the Moone, which is an opinion now exploded by the best

Danæus Philos. Christ. p. 2. c 8. Cardan. de subtil. lib. 2 Valesius contr. lib. 1. cap. 5 Conradus Aslachus de triplici cœlo lib. 1. cap. 4. Laurent. Valla, &c.

Philosophers, and then what becomes of your Antiperistasis? But I shall speake more of this Antiperistasis, *cap.* 13. And as for the reflection beneath, it is a weake thing, and will hardly extend to the top of a steeple: wherfore this coldnesse of the middle region is not from any Antiperistasis, but from the nature of the ayre, which there is not altered either by any influence from aboue, or by any vapours or reflection from beneath.

Neither would it be so cold neere the Poles, if the ayre of it selfe were hot. But the long absence of the Sunne in those parts, and the oblique beames when it is present, doe permit the ayre to enioy his naturall coldnesse. And as the ayre is of it selfe, and in his owne nature cold, so it is probable that it is more cold then water, seeing it hath a greater power of condensation, then water, as we see it congeales water into yce, snow, haile, &c. which the water cannot doe of it selfe. For in the bowels of the earth, where the ayre cannot freely passe, water is neuer found to be congealed, vnlesse it be compassed by some other substance equiualent to ayre in coldnesse, as Quicksiluer, Niter, &c. where cold is drawne into a greater compendium, then in water, by reason of the density of their substances: and in yce and snow, the cold may be greater, by reason of the admixture of ayre. It is likewise probable that earth is more cold then water, if we consider it as it is in it selfe, and not mixed with other heterogenecityes. For as motion causeth heat, and leuity, and raritye, so want of motion, which is in earth, causeth coldnesse, density, and ponderosity. But it is enough for our purpose to proue both ayre and water to be cold. As for moysture, *Aristotle* holds the ayre to be most moyst, and water most cold. *Galen* holds Water to be most moyst. *Aristotles* reason for the predominance of moysture in Ayre is, because

Arist. 1. Meteor. cap. 3.

De ortu & inter lib. 2. & meteor. 4. cap 1. & 4. Gal. de simpl: med. fac. lib. 1. cap. 8. Item de Elementis 1

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it is moſt hardly contained within his bounds: but the termination of things, proceeds from their oppoſite qualities, as moyſture is terminated by dryneſſe, and dryneſſe by moyſture: and dryneſſe doth as eaſily terminate moyſture, as moyſture doth terminate dryneſſe. And this difficulty of termination in ayre, may more properly bee aſcribed to his thinneſſe and tenuity of parts, then to his moyſture. For dry exhalations will extend themſelues as well as moyſt vapours; and as it is denſity that compacts, ſo it is rarity that extends. Fire it ſelfe is more hardly bounded then ayre, and yet, not moyſt. Thoſe that would reconcile theſe differences, doe alledge that *Galen* ſpeakes as a Phyſician, and meant that water was *humidiſſimum medicamentum*: *Ariſtotle* as a Philoſopher meant it to be *humidiſſimum elementum*. But this reconciliation giues little ſatisfaction. For how could water be *humidiſſimum medicamentum*, if it were not *humidiſſimum elementum?* For the ſimple qualities are more intenſe in the elements, then in mixt bodies, *cæteris paribus*. We ſpeake of the proper operation of water according to his naturall qualitie, and not as it may worke by accident. Thinneſſe and leuitie are two other qualities of ſimple water, which *Hippocrates* commends, and addes this experiment in another place, that it is quickly hot & quickly cold. *Galen* addes another experiment in the quick boyling of Peaſen and Beanes.

Valeſius cont. lib. 1. cap. 2.

De aere, aquis & locis.

De morbis popularibus lib. 2. ſect. 2.

And whereas *Galen* produceth the boyling of Beanes as a familiar example to ſhew the tenuity of water, wee may gather that the vſe of Beanes was common in thoſe dayes, although the Pythagorian ſect did then much flouriſh, which were thought to forbid the vſe of them. But I finde that here hath beene a great miſtake. For *Ariſtoxenus* who wrote of the life and doctrine of *Pythagoras*, affirmes that he did delight much in that

Brutinus de re cibaria. Platerus in praxi.

kinde of food: and our Phyſitians commend them for looſing the belly, and drying of rheumes. But it ſeemes the cauſe of this miſtake was a verſe of *Empedocles*, Δρλοι παιδιλοι κυάμων ἀπὸ χεῖρας ἔχεσθε. *cyamis ſubducite dextras.* As if he had forbidden the vſe of Beanes, a poore occaſion to pronounce them miſerable which vſed them. But he meant it of continency and abſtinence from venery, as *Aulus Gellius* doth interpret it: where κυάμοι are vnderſtood to be *teſticuli*. *Cicero* mentioneth the ſame of the Pythagorians, but in another ſence, becauſe Beanes were thought by their flatulency, to diſturbe our dreames, and ſo to hinder the diuination which might be gathered from them, as alſo *Middendorpius* iudgeth: But to returne to water: And it is requiſite that water ſhould haue theſe qualities, in regard of the manifold and neceſſarie vſes of it, both for Man and Beaſt, and Plants: inſomuch, as there is no liuing for any creature, where there is no water. It was our firſt drinke to quench our thirſt, and to diſtribute our nouriſhment as a *vehiculum*, which it doth by his tenuitie; and after the inuention of Wine, it was mixed therewith, as *Virgil* ſaith of *Bacchus*, *poculaque inuentis Acheloia miſcuit vuis*; where, by *Acheloia*, hee meanes not onely the water of the Riuer Achelous in Etolia, but all other waters, as *Macrobius* proues out of *Ariſtophanes* and *Ephorus*: and *Scaliger* ſaith that the Greekes called all waters by that name, from the word λέδν. And ſince the planting of Vineyards, ſeeing all Countries could not beare Grapes, *Bacchus* alſo taught the world to make *vinum è frugibus* with water, as *Diodorus Siculus* reports, from whence the Egyptians had their *Zithum* and *Curmi*, the Spaniards their *Cerea*, the Turkes their *Cowſet*, and wee our *Ale* and *Beere*; all which are extracted out of Corne, by the pureneſſe and

Noct. Attic. lib. 4. cap. 11. de Diuinat. 1. In Ariſtæum quæſtione 19.

Brutinus de re cibaria lib. 16. cap 7.

Saturnal. lib. 5. cap. 18.

Rerum antiquar. lib. 4. cap. 21.

tenuitie

tenuitie of water. By meanes whereof wee haue our Brothes, Syrupes, Apozemes, &c. extracted with it, as a fit menſtruum to receiue the faculties of all medicaments and nouriſhments, eſpecially the ſecond qualities, and therefore it was anciently called *Panſpermia*: beſides the manifold vſes in waſhing, dying, &c. where that water is accounted beſt, which lathers moſt, being mixt with ſoape, of which I will not diſcourſe farther. Leuitie is another note of pure water, alledged by many, and ſerues well to diſtinguiſh it from many mixed waters, whether we reſpect the weight of it, or the moleſtation which it breedes in the bowels. This difference of weight is hardly diſcerned by ballance, both becauſe ſimple waters doe very little differ in this point, and alſo many mix waters, if they be onely infected with Spirits, and not corporall ſubſtances, retaine the ſame proportion of heauineſſe with ſimple water: and alſo becauſe it is hard to haue great ballances ſo exact, as a ſmall difference may bee diſcerned by them, yet *Agricola* reports that a cotyle of the water of Pyrene and Euleus, did weigh a dram leſſe then the water of Euphrates, or Tigris, and therefore the Kings of Perſia vſed to drinke of it, and held it in great account, as alſo the water of the Riuer Coaſpis. Thus much for the qualities which ſimple water ſhould haue; for ſuch as it ſhould not haue, I ſhall not need to ſpend time in diſcourſe, being either ſuch as the ſenſes will diſcouer, if it be in taſte, colour, ſmell, or touch; or the effects, if it be purgatiue, vomitory, venomous, &c.

Baccius lib. 1. c. 7

De nat. eor quæ effl. è terra lib. 1. cap. 15.

Langius Epiſt. lib. 1. Epiſt. 31.

Cap. 3.

Of the three originals of simple waters.

Baccius lib.1. cap.3.4. Agric. de ortu & cauſis ſubterr. lib. 1. cap. 1,2,3,4,5, 6,7,8,9. Solinander lib.2 cap.1.& lib.1. cap.3.

NOw it followeth that we ſhew from whence theſe waters haue their originall, which is no other then of the mixt waters, ſauing that the mixt waters doe participate with ſome minerals which are imbibed in them:

They haue three ſeuerall Originals: the one from moyſt vapours congealed by cold in the ayre: the ſecond from the earth, the third by percolation from the Sea.

For the firſt, it is certaine that our Springs and Riuers doe receiue great ſupply of waters from the Ayre, where vapours being congealed by cold, doe fall downe vpon the earth in raine, or ſnow, or haile, whereby the ground is not onely made fertile, but our Springs are reuiued, and our Riuers increaſed. As we ſee the Rein and Danubius to ſwell more in ſummer then in winter, becauſe then the ſnow which continually lyeth vpon the Alpes, doth melt by the heate of the ſunne, and fils thoſe Riuers, which haue their Originals from thence vp to the brinkes. Alſo we ſee daily after much rain, our ſmall Lakes and Riuers to be very high. Alſo vpon much dryth our Springs faile vs in many places, which vpon ſtore of raine doe ſupply vs againe with water. And this is the cauſe that in moſt parts of Africa, neere the Equinoctiall, where it raines little, they haue little water; and many times in two or three dayes iourney, can hardly finde to quench their thirſts and their Camels. *Leo Africanus* ſpeakes of an Army wherein were many Camels, which in their marching, comming to a Riuer, (perhaps it was but a Brooke) did drinke it dry. So that

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we must acknowledge that the earth receiues much water this way. But how this should serue the bowels of the earth with sufficiencie for the generations there, and for perpetuall springs, is very doubtfull; whereas *Seneca* saith that these waters doe not pierce aboue ten foot into the earth: neither if there were passages for it into the bowels of the earth, can the hundred part of it be imployed this way, but is readily conueyed by Riuers into the Sea. Wherefore although much water be yeelded to the superficies of the earth by raine, and snow, and haile from the ayre, yet not sufficient to maintaine perpetuall Springs; seeing many times, and in many countries these aëriall supplies are wanting, or very spare, and yet the Springs the same. Wherefore *Aristotle* his opinion, which attributes all to aëriall water and vapours, from thence, is iustly reiected by *Agricola*, and by our country-man Master *Lydiat*. So that wee must finde out some other Originals, or else wee shall want water for the manifold vses the earth hath of it. From the earth they make another originall of perpetuall Springs & Riuers, seeing the first seemes to be ordained by nature onely for the irrigation of the superficies of the earth, which else would be in most places destitute of water, where Springs are not, and so would bee barren, plants and trees wanting due moysture for their nourishment. Wherefore for the perpetuitie of fountaines, and for Subterraneall generations, which cannot proceede without water, they haue imagined a generation of water within the earth; some holding that the earth it selfe is conuerted into water, as elements are held to bee mutable and conuertable, the one into the other. As *Ouid* saith of the conuersion of Elements: *Resolutaque tellus in liquidas rarescit aquas, &c.* But we must grant *Ouid* his poeticall liberty, and not tye his words to such

Quæst. natur. lib. 3. cap 7.

2 Meteorol. & 1. 3.

De ortu & causis subt. lib. 1. c. 6.

De orig. font. cap. 1.

Metam. 15.

such a strict sence although *Scaliger* in his Criticks would not pardon a Philosophicall errour in the first verse of his Metamorphisis, for saying that formes are changed into new bodies. But vnlesse there bee some reciprocation betweene water and ayre, the other elements are not conuertible the one into the other. For neither fire will be conuerted into any other element being superiour vnto the rest, and not to be mastered by cold, which onely must be the agent of the conuersion of it by condensation: neither will earth be conuerted into water, or any other element, as *Plato* thinkes in *Timæo*, and *Aristotle* 3. *de cælo cap.* 7. for either heate or cold must conuert it. Heate cannot doe it, although it rarifie and attenuate, both for that it consumes moysture, and also because water is cold, which it should not be, if it were made by heat; for euery naturall Agent workes to that end that it may make the Patient like it selfe: and heate may conuert earth into fume and dry exhalations, but not into water, for all water which is not eternall, is from cold; likewise cold cannot conuert earth into water, because cold doth congeale, condense, and congregate, and indurate, and not dissolue and attenuate, &c. as wee see in Amber and Gummes. Neither will water be conuerted into earth. For by heat it turnes to vapour and ayre, by cold into ice and stone; wherefore the Elements are not changed the one into the other, vnlesse it bee water and ayre, which haue more affinity and more neighbourhood then the rest. And yet it is doubtfull, as I haue said in the former chapter: but this generation of water from the earth is impossible. Others will haue great receptacles of ayre within the earth, which flying vp and downe, is congealed by the coldnesse of Rockes into water, to supply all wants. Others imagine huge Lakes and Cisternes,

Aristot. 4 meteor. cap. 10. & vltimo.

Valesius de sacra philosoph. passim.

primarilie

primarilie framed in the earth,and ſupplied with water, either from vapour or ayre,or from the ſea; which water either by agitation,by windes,or by impulſion from the ſea, or by compreſſion of Rocks, is eleuated to the Superficies of the earth: or elſe vapours from thence, made by attenuation, either from the Sun and Starres, or from Subterraneall fire kindled vpon Sulpher and Bitumen; which vapours aſcending to the tops of mountaines, are there congealed into water by the coldneſſe of the Rockes; where there muſt be other Ciſternes or Caſtles in the ayre to feede the inferiour Springs. Others will make the earth to be an animal, and to ſucke water by veynes, to ſerue his turne for generations and nutritions. But why ſhould it ſucke more then it hath neede of? and how ſhall it caſt it forth beyond the place of vſe, to the ſuperficies of the earth? Vnleſſe they will ſay that the Mynes which ſucke it, doe puke it vp as Infants doe when their ſtomackes are full, which is abſurd to ſay. Theſe and ſuch like deuices are produced for the maintaining of their Originall; which as they are all inſufficient to afford ſuch a proportion of water as is requiſite, ſo moſt of them are ſo improbable, and full of deſperate difficulties, as I am vnwilling to ſpend time in the rehearſing of them,or their Authors, much more vnwilling in confuting of them, to trouble my ſelfe,and offend my Reader, onely the point of Subterraneall fire which hath taken deepeſt impreſſion in moſt mens mindes, I ſhall ſpeake of hereafter,when I come to ſhew the cauſes of the actuall heate of Springs. The third Originall is from the Sea,a ſufficient ſtorehouſe for all vſes, and whereunto the other two may be referred. For that which fals from the ayre, and that which is bred in the earth, doe proceed principally from the Sea. *Agricola* for feare of wanting water for his Springs, is contented

De ortu & cauſis ſubter. lib. 1. cap 5. & 9.

to admit of all these Originals, although he relyeth least vpon the Sea, because he knowes not how to bring it vp to the heads of his fountaines, but is contented it should serue for lower places neare the Sea coast. As I remember I haue seene in Zeland at Westcapell, fresh Springs colated from the Sea, through bankes of sand. But I make no doubt but that the Sea water may serue all other Springs and Riuers whatsoeuer, although both farre remote from the Sea, and high in situation. Neither shall we neede to flye for helpe to those monstrous conceits of Agitation, Compulsion, Compression, Suction, Attraction by the Sunne, &c. But holding the sacred Canon of the Scriptures, that all Riuers are from the Sea, &c. I perswade my selfe, that there is a naturall reason for the eleuating of these waters vnto the heads of Fountaines and Riuers, although it hath not yet beene discouered. For those opinions formerly mentioned will not hold water.

Ecclesiastes 1.

My conceit therefore is this, that as we see in *Siphunculis*, that water being put in at one end, will rise vp in the other pipe, as high as the leuell of the water (whether by his weight, or by the correspondence with his leuell, I will not dispute) so it may bee in the bowels of the earth; considering that the passages there are more firme to maintaine the continuitie of the water with the Sea, then any leaden pipes can be, being compassed on euery side with many Rockes: as we see in *Venis, fibris & commissuris saxorum*. Now although perhaps this water enters into the earth very deepe, yet the leuell of it must answer to the superficies of the Sea, which is likely to be as high as the superficies of the Land, seeing the natural place of waters is aboue the earth. And although neere the Coasts it bee depressed and lower then the Shoare, yet there is reason for that, because it is termina-

Arist. meteorol. cap. vltimo lib. 1.

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ted by the dry and solid body of the earth: as we see in a Cup or Bowle of water filled to the top, we may put in a great bulke of siluer in pieces, and yet it will not run ouer, but be heightened aboue the brims of the bowle. The like we see in a drop of water put vpon a Table, where the edges or extremities of the water being terminated by the dry substance of the Table, are depressed, and lower then the middle, like a halfe globe: but take away the termination by moystening the table, and the drop sincks. If this be euident in so small a proportion, we may imagine it to be much more in the vast Ocean: and our Springs being commonly at the foot of hils, may well be inferiour to the Globe of the Sea, if any be higher, they may perhaps be fed from raine and snow falling vpon the mountaines. But if *Iosephus a Costa*, his assertion be true, that the Sea towards the Equinoctiall, is higher then towards the Poles, then the leuell of the Sea may bee much higher then the top of our highest hils, but this is a doubtfull assertion: yet I dare beleeue that if it were possible to immure a Spring without admission of ayre, which might breake the continuitie with the Sea, our Springs might be raised much higher. At Saint *Winifrids* Well in Flintshire, though there be no high land neere it, yet the Springs rise with such a violence, and so plentifully, that within a stones cast, it driues a Mill. It is likely that this Spring might be raised much higher, And whereas we see that Riuers doe run downewards to the Sea *per decliue*, it doth not proue the Sea to be lower then the Land, but onely neere the shore where it is terminated, and in lieu of this it hath scope assigned it to fill vp the Globe, and so to be as high as the Land, if not higher. For if a measure should bee taken of the Globe of the earth, it must be taken from the tops of the Mountaines, and from the highest of the

Sea, and not from the Vallies, nor from the Sea-coasts. This conceit of mine I was fearefull to publish, and therefore had written vnto Master *Brigges*, mine ancient friend, for his aduice in it, being a point wherein he was well studied: but before my Letter came to Oxford, he was dead. But now I haue aduentured to publish it, to stir vp others to search out the causes hereof, better then hath yet beene discouered. *Exors ipse secandi, fungor vice cotis.*

Cap. 4.

Diuision of Minerall Waters. Minerals described. Their kindes recited. Of earth, simple and mixed. Whether it giue any medicinable qualitie to water: And so of the rest in the following Chapters.

THus much of simple waters, and their originals, which may serue as *Polycletus* his rule to iudge mixed and infected waters by: as *Galen* in many places speakes of an exact and sound constitution of body, as a rule to discerne distempered and disproportionated bodies. And thus much in explication of the *Genus*, in the definition of Minerall waters.

Now I come to Minerall Waters, and to the other part of the definition which wee call difference, &c. from Subterraneall Mynes by Imbibition.

These Minerall waters are either simple or compound; simple, which partake but with some one Subterraneall Minerall; compound, which partake with moe then one. And these waters partake with Minerals, either as they are confused with them, or as they are perfectly mixed. Also these minerall waters, whether simple or compound, are actually either hot or cold; the

reason

reason whereof must proceede from some Subterraneall cause, as shall be shewed hereafter.

Wherefore wee must first know the nature of these Subterraneall Minerals, and their generation, from whence Minerall waters receiue their difference, from common simple water, before wee can iudge of the nature and qualitie of them, either Actuall or Potentiall.

By Minerals, we vnderstand all Inanimat perfect bodies, bred in Mynes within the bowels of the earth. I dare not vndertake to muster these in due order by Dicotomyes, seeing neither *Agricola* nor *Fallopius*, nor *Libanius*, nor any other that I know, haue exactly done it, nor satisfied either others or themselues in it: and seeing there are diuers Minerals lately discouered, and perhaps more may bee hereafter, which haue not beene knowne in former times, and therefore not mentioned; as *Calaem* in the East Indies, *Rusma* and *terra ghetta* in Turkey, &c. Wherefore I will make bold to reckon them vp as they come to hand in seauen rankes.

The first shall be earth.

Earth whether it be bred *ab exhalatione sicca refrigerata*, or *ex mistis per putredinem in fimum cõuersis*, or *ex lapidibus sole aut calore coctis & deinde aqua solutis, &c.* it is all inconcrete. As a little water gleweth it together in *Lutum*, so a great deale dissolues it. But this is no proper dissolution, but onely a disioyning of parts by Imbibing the moysture which conioyned them, into a greater proportion of water; for waters doe naturally runne together, like drops of quicksiluer, or melted mettall. Wherefore seeing the moysture which is in the earth, is not naturall, but aduentitious, not vnited essentially, but onely mixed acidentally, it may well bee called an *inconcrete* substance, whose moysture is easily drawne from it, being readie to vnite it selfe with other

moysture, and leaue his old body as it found it, that is, dust: yet so as that water retaines with it some taste or qualitie which it receiued from the earth. This dust is neither a simple body, as Elements are, nor permanent in one and the same kinde: but as it is thought to participate with *animales vegetables*, and minerals, so to be transmuted into any of them, being both Mother and Nurse to all terrestriall bodies.

Agric de nat. fossil. lib.1. cap.4.

Simple earth, if it be not mixed with other substances, is dry and cold, and Astringent. But if it bee mixed, as commonly it is, it altereth his qualitie according to the mixture. Mine intent is to write of it as it is simple, and so of the rest.

Simple earth yeelds but a muddie water of it selfe, and of no vse in Physicke, but if it be mixed with other Minerals, it makes the water to participate with the quality of those Minerals also. As if it be mixed with niter, as in Fullers earth and Marle, it makes the water abstergent like Soape. If with Allum or Copperesse, astringent and more desiccatiue, as in all sorts of Boles. If with Bitumen, fattie and Vnctious, as in Turfe and Peate, &c. We haue diuers examples of all sorts. The Bath of Mount Othon in Italy is full of clay, which is a kinde of Bole. The Bath Caldaria, full of Ocre. The Bath of Saint *Peter* full of a yellow earth, tincted belike with some other Minerals. Wherefore these are to be iudged of according to the seuerall Minerals which they containe. But seeing earth it selfe makes little impression into water, neither doe we make any Physicall vse of waters, which containe nothing but earth, I need not spend any time about them.

Baccius lib. 5. cap.14

CAP.

Cap. 5.
Of Stone:

THe ſecond ſhall be Stone. Stone is another Minerall ſubſtance, concrete and more heauie then earth, and our Minerall men confound themſelues much in the definition of it. Wherefore *Fallopius* implores the help of *Marcus Antonius Ianna* about it, as one of the moſt difficult points in Philoſophie: but in the end, defines it by his want of diſſolution, either by heate or moyſture. And whereas it is manifeſt that ſome Stones will melt, he imputes it to the admixture of ſome mettall, among which he reckoneth glaſſe. Others define it by his hardneſſe, wherein commonly it goeth beyond other Minerals. But you ſhall haue ſome ſtones ſofter then ſome of thoſe, and therefore the definition is not good. Others by this, that being broken or calcind, they will not bee conſolidated againe into their former conſiſtence or ſhape. But for breaking, the reaſon of that, is want of fuſion; for without fuſion or ignition, which is a kinde or degree of fuſion; Mettals alſo being broken, will not be conſolidated into the ſame Maſſe againe. And there is no more difference in nature or eſſence, betweene a whole ſtone and a broken, then there is betweene a maſſe of Mettall, and the powder or filings of the ſame. As for calcination, other minerals may be ſo farre calcind, and brought to a Crocus by fire, as they will be irreducible, therefore this is not proper to ſtone. Wherefore I am of *Fallopius* his opinion in this point, and the rather becauſe otherwiſe there would ſeeme to be a ſpecies in nature wanting, if there were not Minerall Species wanting, diſſolution by heate or moyſture, as well as there are, hauing ſuch diſſolution: And this *vacuum* which nature

De metallis cap. 6.

natures abhorres, is not onely to be vnderstood of a local vacuitie, but also of a want of such species as are in natures power to produce, for the ornament of the world. For if it be a naturall passion to be dissolued, it is likewise a naturall passion not to bee dissolued: and if some things will bee dissolued both by heate and moysture, as Salts, why should there not be other substances which will be dissolued by neither of them. And this must be stone, for nature affords none other. Moreouer according to *Aristotle: Quæ concreuerunt a frigido & a calido, a nullo istorum dissoluuntur.* Of this kinde are Stones which could neuer attaine to such puritie as many of them haue, if they were not congealed by heate as well as by cold. Also vnder what species shall we comprehend, Diamonds, Talcum, blacke Lead, which some thinke to be *pnigitis, Magnetis, Glymmer, Katzensilber, pyrimachus, amiantus, alumen plumosum, saxum arenarium mortuum, &c.* if not among Stones? yet these are confessed to be inuincible by fire or water. Also all pretious Stones, the more noble and pretious they are, the more they resist dissolution either by fire or water: for this qualitie sheweth the peefection of their mixture. True it is that some stones wil bee dissolued by fire or water, and therefore *Pliny* and *Agricola* diuide Stones into fusible and infusible: but this is in regard of other substances bred in the stone; which if it be Metall, the fusion will be Metallin: If Niter or meane Minerals, it will be vitrificatorie. As *Pliny* reports of the inuention of Glasse by certaine Merchants, who melting Niter vpon the sand in Syria, where with clods of Niter they had made a furnace for their necessary vse; found that cleere metall which we call glasse, *Ecce liquato nitro cum arenis visi sunt riui fluxisse nobilis liquoris.*

If Sulphur, as in *pyrite*, it will likewise melt and strike

fire.

fire. And whereas the ſtriking of fire out of a flint or pyrites, or any other thing that will ſtrike fire, is held by all men to proceede from the kindling of ayre, by the colliſion of two hard ſubſtances together, they are miſtaken. For then Diamonds, Chryſtall Glaſſe, &c. ſhould ſtrike fire as well as flints; but it is the Sulphur contained in them: And *G. Fabricius* in his obſeruations, although he obſerues not the reaſon of this fire, yet he confeſſeth that out of any Pyrites *è quo excutitur ignis, etiam excoquitur ſulphur.* *Pliny* giues the reaſon of the name, *quia ineſt ignis illi.* The like we obſerue in Indian Canes, and ſome Woods that are vnctuous, and full of oyle, which will yeeld fire by frication, or colliſion, not by kindling the ayre thereby, but the inflamable oyle in them. For ayre being cold and moyſt, as hath beene proued before, hath no agreement with fire, no more then oyle hath with water. And therefore flame is not the kindling of ayre (*flamma non eſt aer accenſus*) but of fuliginous vapours, which haue ſome vnctuouſneſſe in them, and ariſe from the matter of fewell, and haue ſome imflamable parts remaining in them: which neere vnto the matter of fewell, doe cauſe a manifeſt flame: but farther off, no flame doth appeare: yet ſo as if you hold flaxe neere vnto the flame, though it touch it not, yet it will kindle, by reaſon the fire extends further then it is viſible, being a pellucide and tranſparent body, and thinner then the ayre it ſelfe. And this is held to be the cauſe why it is not viſible vnder the Moone. And whereas without ayre fire goes out, and is extinguiſhed, the reaſon is, becauſe the fuliginous vapours wanting euaporation, doe recoyle vpon the fire and choake it. This is euident in cupping glaſſes, and in making of Char-Coale: where if the ayre be altogether excluded, the fire goes out; if but in part,

Verulanius de vita & morte, pag. 418. & 453

then although the flaming be hindred, yet the fire doth penetrate the fewell, and so conuerts it to coales: which by reason of the fuliginous vapours, are commonly blacke. *Bellonius* saith that Char-Coales made of the wood of the Oxycedar tree, are white; which must be ascribed as I thinke, to the small quantity of fuliginous vapours which that wood doth yeeld: or else that those vapours are rather sulphurous, then of any other combustible substance. As we see that Tinby Coales will not blacke linnen, being hanged in the smoake of them, but rather whiten it, by reason of the drying and penetrating quality of sulphur, which will make red roses white.

De neglectâ stirpium culturâ problem. 13.

But what shall wee iudge of those Lamps, which haue beene found burning in old Sepulchres? some of them (if wee may beleeue histories) hauing continued 1500. yeers together, as that which was found in *Paulus* the third his time, of *Tullia, Ciceroes* daughter: and another of *Maximus Olibius*, neere vnto *Padua*, as *Bernardinus Scardeo* reports. It seemes here was no ayre to maintaine the Lampes, being closely shut vp in glasses, and therefore they burnt without ayre, and were not extinguished, by reason they bred no fuliginous vapours to choake them.

Now whether these oyles which fed the Lampes were made by Art out of gold, as some think, & I hardly beleeue, or rather out of some pure kinde of Naphtha, which is most probable, I leaue to others to iudge: onely I iudge it to be the purity of that oyle, which yeelded no fuliginous vapours to choake the fire. If ayre had maintained the flame, it had not continued two minutes, for it would haue beene spent and wasted by the fire. Wherefore *ignis non est aer accensus*. If other concrete iuyce be mixed with stone, as Salt, Allum, Vitrioll,

Vitrioll,&c. it makes them to relent in water or moyſt ayre; and theſe ſtones are neuer good to build withall. But let vs take ſtone as it is in it ſelfe, without the admixture of other Minerals, and we ſhall finde it to be indiſſoluble and inuincible, either by fire or water. *Eraſtus diſput. part. 2. pag. 105.*

Metallurgians, Refyners, and Aſſay maſters, may make vſe of this for their Shirbs, Tiegles, Muffels, Copels, Teſts, Hearths, Crucibles, furnaces, &c. where they deſire a defenſible ſubſtance againſt fire. But it requires a preparation to cleere it from all combuſtible and diſſoluble admixture: as they may eaſily doe, after they haue powdred their ſtone, to calcyne it and waſh it well. This worke being often repeated, will make it fit for their purpoſe: and they may vſe it either alone in the ſame manner as they doe bone-aſhes, or they may mixe it with their lome, bricke duſt, geſtube, &c. Alſo they may make brickes of it for their furnaces, which will hardly receiue any iniury from fire. Talcum alſo is a ſtone inuincible of it ſelfe by fire: and Bricks made of clay that is full of it, as the Guendern clay in Cornwall, will hardly melt with any heat. Stones are naturally dry and cold, and aſtringent like a concrete earth.

Simple Stones which haue no other Minerals mixed with them, and are come to their perfection, being indiſſoluble, either by fire or water: can yeeld no qualitie or vertue to Bathes, and therefore hee that ſeekes to draw any vertue from ſtone into water, doth *lapidem lauare*, that is, labour in vaine. But by reaſon of admixtures, they may, or whileſt they are in *ſucco lapideſcente*, before they are concreted. For if it be certaine that metals may yeeld vertue to Bathes, being alike indiſſoluble by water, there is no reaſon but Stones alſo may. *Fallopius* is againſt it in both, but contradicted by *Iulius Cæſar*, *Claudius*, and diuers others; yet hee confeſſeth

In ingressu ad infirmos p. 373. Venustus in consilio pro Petro Picardo. Baccius etym.

that *Balneum montis Grotti*, hath *Gypsum:* and *Gesner* affirmes the same of the Baths of Eugesta. Also he findes *ramenta marmoris in Balneo Corsenæ & Agnano*, but he iudgeth that they receiue no qualitie but from the iuyce, and I doubt not but he is in the right. And for *succus lapidescens*, we haue many examples in *Agro Pisano & Lucensi* in Italy, in Auernia in France, where this iuyce is so plentifully brought by a cleare Spring, that after it is congealed, the people digge the stones, and haue made a great bridge of them. Also neere Vienna in Sauoy, in a village called Giret, is a cleare fountaine which turns to stones as hard as flints: *Pliny* makes mention of the like Springs in Eubea, which are hot: and *Vitruuius* of the like at Hieropolis in Phrygia: Also *Iosephus a Costa* of the like hot Springs in Guaniauilica in Peru, which turnes to stone, whereof they build their houses. *Anthonio de Herreza, cap.* 20. tels of the same Spring at Guainia vélica, which turnes to stone as it riseth, and kils those that drinke of it. Also this *Succus lapidescens* is obserued in the Bathes of Apono, where it is conuerted into stone vpon the sides of the Bath. Also in the Bath of Rancolani, where this iuyce is not confused, but perfectly mixed with the water, & being imbybed by plants, it hardens them like stone. *Baccius* tels vs of a Caue by Fileg in Transiluania, which turnes water into stone. The like is found at Glainstaynes in Scotland, as *Hector Boetius* reports. In England also we haue many fountaines which turne wood into stone: which must be by reason of this *succus lapidescens* mixed with the water. Corall also being a plant, and nourished with this iuyce, turnes to a stone: so doth the seede of Lithospermon or Gromell. Thus much of stone.

Lib. 6. c. 14.

Cap. 6.

Of Bitumen. His kindes, qualities. Of Camfor in particular. That Bitumen is predominant in the waters of Bathe.

NExt I come to those Minerals which we call *Bitumina*, which are Minerall substances that burne and waste in the fire without metallin fusion, or ingression. The greatest affinity they haue, is with Sulphur: but this hath ingression into mettall, and therefore I ranke it among the Spirits, and Bitumen hath none. Of this kinde some are solid, and some liquid. Solid, as *Succinum, gagates, ambra, camphora, terra ampelis, Lithanthrax, siue carbofossilis, &c.* Liquid, as *petroleum* and *naphtha*. All these are great fuels to fire, especially those that are liquid, which are thought to draw fire vnto them, if it be within their *effluuium*: So *Pliny* reports that *Medea* burnt *Creusa* by anoynting her Garland with Naphtha: and *Strabo* tels how *Alexanders* Bathmaster, *Athenophanes*, had almost burnt *Stephanus*, a boy in the Bath, by sprinkling Naphtha vpon him, if it had not beene suddenly quenched. And this is that iuyce or thicke water which *Plato* in *Timeo* reckons among fires, and which the Egyptians vsed in their sacrifices, and was hidden by the Iewish Priests in a dry pit for 70. yeares, and afterwards found by *Nehemias*: 2. Machab. 2. 1.

But whereas it is a common receiued opinion, that some of these *Bitumina* will burne in water, I cannot beleeue it: although *Pliny* and *Agricola*, and most that haue written since, out of them doe auerre it, and bring arguments and examples to proue it. For although water were a fewell to fire, as oyle is, yet there can be no fire without ayre, and water excludes ayre: and so doth

oyle, if the fire be beneath it, and couered with it? As for their arguments, they say that Bitumen being besprinckled with water, burnes more, and therefore water is a fewell to it: as we see that Smiths cast water vpon their Sea-cole in their Forges: but the reason of this is, because their Coale being small like dust, the water makes it to cake and bake together, where otherwise the blast would blow it away: also it hinders the quicke burning of it, and so makes it continue the longer: so in a *Vulcano* after raine, they finde the fire to burne more, when the Bitumen is small, and in dust. Although this may be a reason of it, that the Lyme which hath there beene calcined, being by raine dissolued, increaseth the fire. And whereas they say that water will kindle Bitumen, and quench Sulphur, it is not so: neither doth their example of Wilde-fire proue it. For in Wild-fire, besides Bitumen and Campher, there is a double proportion of quicke Lyms, which by reason of the sodaine dissolution of his Salt, by the effusion of water, is apt to kindle any combustible matter; not by reason of any Bitumen in the Lyme, as some imagine, nor of any *Empyreuma* which the fire hath left in it, as *Fracastorius* thinks: for, how can there be any Bitumen left in the Lyme (if there were any at first,) after calcination: the fire would haue consumed that before any thing else. And as for any *Empyreuma*, it is certaine that the more any thing is burnt, although the fire leaue an adustion in it, the lesse apt it is to burne againe, especially being burnt and calcind *ad calcem aut cineres*, where all the combustible matter is spent. Wherefore it must needs be by the violent motion which is in the sudden dissolution of the salt in it, as appeares by the crackling it makes: *Et ex motu fit calor*. The like wee obserue in *Pyrite sterili*, whereof they make Vitrioll, which being

De sympath. & antipath cap. 10.

broken

broken and laid vp in heapes, and moyſtned with water, will gather heat, and kindle any combuſtible matter put to it. The like alſo wee finde in Allum myne, &c. where thoſe mineral iuyces being concrete in the Myne, when they come to ſuddaine diſſolution doe grow hot, and will kindle fueil. And as for the example of the ſalt Lake whereof *Agricola* writes, betweene *Strapela* and *Seburgh*, which burnes the fiſhermens nets if they bee put neare the bottome, and of the lake *Sputa*, in *Media*, mentioned by *Strabo*, which burnes clothes put into it: I take that to be by reaſon of the corroſiue quality of the ſalt which frets them, being ſtronger neare the bottome; and not from Bitumen, as *Agricola* thinks. The like I iudge of the Lake by *Denſtadt* in *Turingia*. And it is very probable that ſalt being heauier then water, will be moſt towards the bottome: as it is reported of the fountaine *Achilleus* in *Mileto*, whoſe water is very ſweet and freſh aboue, and very ſalt towards the bottome. So is the water of *Agnano* in *Italy*, as M. *Sandys* reports in his trauels. And the more heauy and terreſtriall any ſalt is, the more corroſiue it is: and ſo contrariwiſe, the more corroſiue, the more heauy. *Ariſtotle* affirmes the ſea water to be more ſalt at the bottome then aboue: and ſo doth *Pliny*, who likewiſe makes mention of the Lake *Aſcanius* in *Chalcide*, whoſe top is ſweet, and bottome nitrous. *Baccius* writes the like of a Well neare *Toletum* in *Spaine*, the water whereof is ſweet aboue, and corroſiue beneath: which he iudgeth to be from Quick-ſiluer. *Fallopius* is alſo of opinion, that Bitumen doth not only burne in water, but is nouriſhed by water, becauſe it makes the fire to laſt longer. But I haue ſhewed the reaſon of that before. And for the burning in water, he ſhould haue ſaid vpon the water; for there it wil burn as long as it ſwimmeth; but dip it vnder the water, and it is preſently extinguiſhed.

De nat eor. q. effluè terra. l. 4 c. 22.

Meteor. 2.

Lib. 2 c. 11.

De Thermis. c. 5.

And

And whereas some report that Queene *Anne* of blessed memory, being in our Kings Bath, there arose a flame of fire like a candle from the bottome of the Bath to the top neare vnto her, they must giue mee leaue not to beleeue it, but rather to thinke they were mistaken: for, I am not bound to beleeue any thing against reason, which God hath giuen mee to bee my guide. It might haue beene some bubble of winde which is frequent in our Bathes, or some Bituminous matter not dissolued in the water, did arise, and being at the top, dissolue it selfe vpon the surface in the forme of a circle: but it could not be kindled. And if it might bee kindled in the water (which were impossible) yet in all likelihood it would haue burnt better aboue the water then within it, and not be presently extinct, as they report. These *Bitumina* (excepting Camfer) are potentially hot and dry in the second or third degree; but concerning Camfer there are two doubts. First, whether it be a Bitumen or a Gum. Secondly, whether it be hot or cold. The Arabians affirme it to bee the Gum of a huge tree with white leaues, vnder whose shadow many wild beasts may lye: and that after earthquakes there is great plenty found; that it is in quality cold and dry in the third degree; some late writers follow them in their opinion of a Gum, as *Mathiolus*, *Amatus Lusitanus*, *Garrius ab horto*, *&c.* *Platearius* holds it to bee the iuyce of an herbe. But we must consider that they make two sorts of Camfer, the one of *Borneo*, the other of *Chyna*. For that of *Chyna* they confesse it is adulterated with Bitumen: and that is the onely Camfer in vse with vs. But that of *Borneo* to bee a simple Gum, and that a pound of this is valued as deare as an hundred pound weight of the other. So that all the doubt lyeth in this Camfer of *Borneo*; which whether it be a Gum

Seraphio de simp. m. d. c. 344. Auicen. lib. 1. tract. 1. c. 2. Item l. 2. tract 2. cap. 133. Item de med. cordial. tract. 2. cap. 3.

or

or no, is ſtill in controuerſie. For the Arabians not trading into thoſe parts, had the notice hereof onely from others, as *Serapio* and *Auicen* doe confeſſe: and *Amatus Luſitanus* ſaith that the inhabitants will not ſuffer ſtrangers to come aſhore to ſee it. So as wee haue beene kept in ignorance a long time from the true knowledge of it. And *Garrias ab horto* tels vs, that all his knowledge of it, is but by relation: himſelfe not being able to trauell to ſee it; partly by reaſon of his age, and partly for his continuall imployment about the Viceroy, yet he ſaith, that he had a piece of the wood giuen him: Onely *Eduardus Barboſa* reports that he did ſee the place in *Borneo*, and found it to be of a minerall nature. But *Barboſa* his teſtimony is not authenticall, hauing fayled much in other of his relations: as where he reports that the Purcelan of *China* is made of Oyſter ſhels, &c. Hee is contradicted by *Conſaluus Mendoſa* a man employed in thoſe parts by the King of Spaine, for ſuch diſcoueries, and alſo by *Hugo a Linſchoten*, a man of great obſeruation, and both of them of farre better credit then he. I procured ſome of that Camphir to bee brought from thence by my worthy friend Captaine *Beſt*, but whether it be a Gum or a Bitumen, by the view I cannot diſcern, But if it be a Gum, ſaith *Solinander*, why ſhould it abound more after earthquakes? and why ſhould it burne and not diſſolue in water? No Gums will burne, and all Gums will diſſolue in water: and earthquakes make no trees fruitfull, but may caſt forth minerals. That there is a naturall Bituminous Camphire, I make no doubt: and *Agricola* proues it ſufficiently: And the Bath in *Remandiola* neare *Rhegium* ſhewes it. Alſo the Well by *Muntzbach*, where *Taberni montanus*, ſaith there is minerall Camphir. *Auerroes* ſaith it is *affinis Bitumini*.

In Dioſcoridem Cap. de maſtich.

Lib. 1. cap. 9.

De nat. foſſil. lib. 4. cap. 2.

Theſaur. aquar. lib. 1. cap. 2.

I confesse that when I published my first edition, I was perswaded by *Solinanders* iudgement, to thinke all Camphir to be a Bitumen, & namely that of *Borneo*, but since vpon better enquiry, I finde it otherwise. For Captaine *Best*, besides the relations made vnto him in the Indyes, concerning this Camphir, that it was from a tree, hath also procured mee the testimony of Master *Andrew Cogganell*, vnder his owne hand, that both the Camphir of *Borneo* and *Sumatra*, are gums of a tree, and no Bituminous matter, himselfe hauing beene at the gathering of it, and at the cutting downe of some of the trees. He hath also traded much in that commodity, and vented it at *Iapan*: where it seemes, as also at *Chyna*, they mixe and adulterate it with some other matter, to increase the substance, and abate the price: which mixture perhaps may be some Bituminous substance. This Master *Cogganell* hath liued 14. yeeres in those parts, and speakes the vsuall language, and hath beene often vpon that Iland of *Borneo*.

Now for *Solinanders* reasons, they are easily answered: no Gums, saith he, will burne, and all Gums will dissolue in water. I grant it, if you take the word Gum in a strict sense, for watry Gums, as Tragacanth, Arabicke, &c. But we vse the word Gum in a more generall sense, comprehending vnder it all Rosins, Turpentines, Pitches, &c. which being vnctious and oyly, will readily burne, and will not dissolue in water. Among these Gums or Rosins, we reckon Camphir, and so that argument is answered. As for his other argument drawne from earthquakes, mentioned by the Arabians, after which there is commonly more plenty of Camphir: this doth not proue it to be a minerall; For earth-quakes are as apt to cast vp fresh mould, whereby trees are made fruitfull, as minerals. Wherefore let vs subscribe

to

to the ancient Arabians, although they were not eye-witnesses hereof, and to the later obseruations of Spaniards and others: especially now that we haue a countryman of our owne, who hath had as good meanes to learne the truth of this, as any European euer had: who is yet liuing, and able to giue satisfaction to any that are curious in these poynts.

Now for the qualities of it, the most generall and truest opinion is, that it is cold and dry. *Matthiolus* iudgeth it to be hot for three especiall reasons. First, because it burnes, and is a great fuell to fire. If this argument bee good, then flax, and straw, and paper, and touchwood, and spunck should be hot, for they are apt fuels to fire. Secondly, because it is *odorata*, and hee holds all *odorata*, to be *calida*: *Galen* is of another opinion, and holds the iudgement of simples by sauour to be vncertaine. And as for Camphir, *Galen* knew it not. *Auicen* saith expresly of Camphir, that although it bee *odorata*, yet it is *frigida*. And if *Matthiolus* his reason were good, then Roses and Violets, and Vinegar should be hot; for they are *odorata*. It is true that all sauors arise from heat, as *Galen* saith, and all compounded bodies haue some hot parts: but we speake of the predominancy in the subiect, and of the operation it hath vpon mans body. Thirdly, because it bytes the tongue. So doth iuyce of Limons, and Barberies, and Vinegar, &c. and yet they are cold. Wherefore I conclude our Camphir to be in quality cold and dry; and of very subtill parts. These *Bitumina* being vnctious and oylie, dissolue not of themselues in water, without the helpe of some minerall iuyce, but may be confused with it. And wee haue many fountaines and lakes which participate with them. In Shropshire at *Pitchford*, is a Spring that casteth forth Bitumen swimming vpon the water. The like

Comment. in Dioſc & Epiſt. l. 3. Thaddæo Nemico.

De ſimpl med. faculi. l. 4. c. 22.

Lib. 1. tract. 1. c. 2

we reade of in *Auernia* in *France*, between *Claremond* and *Monferan*, where the people gather it for their vses. In *Italy* there are many fountaines, yeelding Bitumen; at *Maianum*, and *Sassoli*, and *Salsa*, and *Herculanum* at the foot of the mountaine *Vesuvium*, at *Baia*, and also at the cape of S. *Helena*, and in the Isle of *Woolfs* there are fountaines of pitchie Bitumen, which are vsed to pitch ropes and tackling, as *Iosephus a Costa* reports. And we haue that famous lake *Asphaltites* in *Iudæa*, so full of Bitumen, that it hardly suffers any thing to sinke in it. The riuer *Liparis* in *Cilicia*, by reason of a Spring neere *Solos*, is so full of liquid Bitumen, as they which swimme or wash in it, seeme to be anoynted with oyle: Also there are Bituminous Springs in *Saxony* at *Bruno*; in *Sweuia*, the lake *Tegera*, at *Gersedorf* vnder the mount *Iurat*; In *Asia* by *Tralleis* and *Nissa*. Also in the West Indies there are many found which they put to vse for shipping. And this Bitumen is the chiefe ingredient in our Baths at *Bathe* in *Sommersetshire*, although diluted with much Niter, which makes the solution the better, and the water more cleare. That Bitumen is predominant in these our Baths, may bee proued by the effects, because wee finde them exceedingly to comfort the nerues, supple the ioynts, dry vp rheumes, cure Palsies, and Contractions, being distinctly vsed, tinct siluer into the colour of gold, &c. Also by the Bituminous sauour of them, and by the neighbourhood of Colemines in those parts. All which doe argue Bitumen to abound in them. And whereas Doctor *William Turner* in his treatise of these Baths, thinketh Brimstone to bee the chiefe minerall, and Copper next; I am not of his opinion. The actuall heat is no argument of Brimstone, as shall be shewed when I come to that point: neither doth the sauour bewray it. But his reason for Copper

Bellonius de Naphtha c.7.

Agric. de nat. eor. quæ efflu. è terra. l.1.c.7.

is

is very weake. Hee found a Marcheſit vpon one of the hils, which he thought to hold Copper, But Marcheſits although they ſhew yellow, yet they ſeldome hold Copper, or any other metall. But his diſcourſe hath perſwaded *Iohn Bauhinus* to publiſh it confidently to the world. I ſhall haue occaſion to ſpeake more of this hereafter. And thus much of *Bitumina*.

De thermis Boll. l.3.c.61.

Cap. 7.

Of Minerall iuyces concrete: called by the Alchymiſts, Salts. The foure principall ſorts of them; Salt, Niter, Allum, Vitriol.

A Fourth ſort of minerals are concrete iuyces which are minerall ſubſtances diſſoluble in water. Theſe the Alchymiſts call Salts, and are the meanes of communicating all other minerals with water. For as water is apt to diſſolue and extract vegetables, ſo are theſe concrete iuyces apt to diſſolue and extract minerall ſubſtances. And although they are found ſometimes liquid being diſſolued by moyſture: yet we call them concrete, becauſe they will be concrete when the aduentitious moiſture is remoued. Our minerall Authors doe make many ſorts of theſe according to the ſeuerall minerals which they imbibe: but in truth they may bee all reduced to foure heads; Salt, Niter, Allum, and Vitriol. And each of theſe hath diuers ſpecies, as *Geber* and *Caſalpinus* ſay of Salt, *quot genera calcium, tot genera ſalium*. Concerning Vitriol there may be ſome doubt whether it be a diſtinct ſpecies from Allum, and haue receiued onely ſome tincture from Copper, or Iron, or from ſome of their brood, which are called excrements. For in diſtilling oyle of Vitriol, the lute

Libauius in Syntagm. p. 221.

wherewith the glasses are ioyned, will yeeld perfect Allum. And Vitrioll being boyld, ariseth *in bullas* as Allum doth, and shoots like Allum *in glebas*; as Salt doth *in tesseras*, and Niter *in stirias*. The shooting or roching of concrete iuyces, is worthy to bee obserued, seeing euery kinde hath his seuerall manner or fashion of shooting, whereby a man may see the perfection of each kinde. For example, if salt Peeter be brought you to examine whether it be perfect good or not, dissolue it in water, and set it to shoot in a wooden dish, or with sticks of Ash, or other poreous wood: and if it shoot in needles, (*in stirias*) it is right. But if any of it shoot in squares or angles, or lumps, it is mixt, and vnfit either for medicine or Gun-powder. The common salt-Peeter being prepared and cleansed with ashes, hath commonly much of the salt of the ashes mixt with it in the liquors, which being brought to shoot, will settle first vpon the wood in squares, (*in tesseras*) and then the salt-Peeter will shoot vpon it in needles. These needles are good salt-Peeter, but the squares are other salt, and weaken the salt-Peter in his operation; the like you may iudge of other concrete iuyces. There are also certaine stones which we call *fluores*, which doe naturally shoot in diuers formes: as Christall into sixe squares (*in sexangulos*) Sparr, which the Dutch call Sput or Querts, shoots into poynts like Diamonds: as wee see in those Cornish or Bristoll stones: *osteocolla* found by *Darmstadt*, in the Palatinat, like bones: others like Oyster or Muscle shels, &c. The reason of this seuerall shooting in concrete iuyces and other minerals, is hard to giue. For if it did lye in the thinnesse or thicknesse, or clamminesse of the matter whereof they were made, that difference were taken away when diuers sorts are dissolued together in the same water, for one would qualifie the other.

other. But we finde that this mixt water will yeeld his seuerall salts distinctly, and all at once. So that it seemes, for the ornament of the vniuerse, that nature hath so distinguished these species, as it doth plants: among which some haue thicke leaues, some thin, some long, round, iagged, &c. some haue bulbous roots, some long, stringy, &c. So in their flowers, fruits, colours, smels, &c. euery kinde hath his owne fashion. The reason hereof *Scaliger* saith cannot bee drawne from the Elements, nor from the thinnesse, thickenesse, clammines, heat, cold, dryenesse, moysture, plenty, scarsity, &c. of the matter: but only from the forme, *anima*, seed, &c. which frames euery species to his owne figure, order, number, quantity, colour, taste, smell, &c. according to the science, as *Severinus* termes it, which euery seed hath of his owne forme. So also it is in minerals, which haue their seuerall and distinct species in nature, and their seeds to maintaine and perpetuate the Species. Now that these concrete iuyces are not bred commonly in these formes in the earth, the reason may be, either because they are often intermixt with other minerals in their generation, or that their matter being plentifull, and roome scanty, they haue not scope to display themselues in their proper formes, or perhaps they want water to dissolue them. But by artificiall preparations, wee finde these distinctions: in which it is doubtfull whether heat, or cold, or dryenesse, doe procure this shooting or roching in concrete iuyces, and whether the same causes procure it in all. For dryenesse it is certaine, that as moysture dissolues them, so dryenesse congeales them: But dryenesse being a passiue quality, is not sufficient; it must be the action either of heat or cold, or both; and the right ordering of these will open a doore to the artefice of Bay-salt here in *England*, as well as in

In lib. de plantis Aristoteli ascriptum lib. 2. passim.

France

France or *Spaine*, or the the Ile of *Mayo*. Among these concrete iuyces, *Agricola* reckons Sulphur, Bitumen, Auripigmentum, Sandaracha, Chrisocola, Ærugo, Mysi, Sori, Melanteria, &c. But if we examine them aright, we shall finde, that either they are not dissoluble in water as concrete iuyces should bee, or they are some of those iuyces tincted or incorporated with other minerals. All these minerall iuyces are accounted hot, and dry, and astringent, and detergent, some more, some lesse: and we take it so vpon trust. But this point requires further consideration and distinction.

Cæsalpinus de metallis c.3. l.1.

Salt is a fixe substance, not volatill in the fire, astringent, detergent, purging, dispersing, repelling, attenuating, makes an escar, and preserues from putrifaction, as *Dioscorides* informes vs, and *Galen* confirmes the same, adding that it is hot. But wee must vnderstand *Galen* with his limitation, *lib. 6. cap.* 30. That the more it is detersory, the lesse it is astringent. And all astringent things are cold, as hee auoucheth, *lib. 4. cap. 6. Acida, acerba, & astringentia omnia frigida.* Now if salt bee astringent, it must bee cold by *Galens* owne rule, and it is not enough to say it hath warme parts in it, but being an vniforme substance, wee must determine of it *ex predominio.* Also *Galen lib.* 1. *Symp. cap.* 4. comparing pure water with sea water, seemes to affirme that sea water, before it haue receiued any great aduentitious cold, may coole our bodies. And so this place is vnderstood by *Anthonius Maria Venustus in consilio pro Petro Picardo*, The repelling quality, and the making an escar, and the preseruing from putrifaction, are arguments of drinesse, and not of heat. For as heat and moysture are principall agents in generation and corruption; so cold and drinesse in preseruation. Also I should impute the purgatiue and detersorie qualities in salt rather

Dios. l.5. c.[1]*84: De simpl. med. facult. l.4. c.20. & l.11. c.50.*

to

to the tenuity of parts, and the ſtimulation which it hath from thence, then to any heat; for then as *Sennertus* ſaith, all hot things ſhould purge; *Inſtit. lib.* 5. *part.* 1. *cap.* 11. *Valeriala in Gal. de conſtit, artis pag.* 447. And *Meſue Canon vniuerſal. cap.* 1. reiects all elementary qualities, temperaments, ſimilitudes, or contrarieties of ſubſtances, &c. in purging medicines. Alſo Tamarinds, Myrabolans, and Antimony doe purge, and yet are cold, *Venuſtus, pag.* 132. But the purgatiue faculty of medicines is from ſtimulation of the expulſiue faculty of the ſtomach and guts, and not from attraction by heat of peculiar humors, as hath beene imagined. Heat may ſerue as an inſtrument to actuate ſtimulation, as cold doth dull and benumbe all faculties, but neither heat nor cold are principall agents in this worke. And whereas Reubarb is thought to purge coller onely, Sene and Polipody melancholy, Agarick phlegme, &c. becauſe we ſee the excrements tincted with the ſame colours; it is a deceit; for theſe purgations doe colour humours in that manner. Yet I doe not deny a diſtinction to be made of purgations in other reſpects. And our ancient Phyſitians through long experience haue found out the right vſe of purging medicines, and their true diſtinctions for ſeuerall vſes for mens bodies: as that ſome doe purge groſſe humors, and ſome thin, ſome are ſtrong, and ſome weake: ſome are comfortable to the ſtomach, or liuer, or ſpleen, &c. and ſome hurtfull to ſome of thoſe parts: ſome are too hot in ſome caſes, and ſome temperate, &c. But they haue not diſcouered the true cauſe of this purging quality: ſome attributingit to a celeſtiall influence, ſome to a hidden quality, which is as much as if they had ſaid nothing: ſome to a Sympathy, Antipathy, &c. For my part I hold the purgatiue quality of mixt bodies to lie principally in the terre-

ſtriall part of them, which is their ſalt: and therefore the Chymiſts vſe to acuate their purging extracts with their proper ſalts. It were much better if they could make their ſalts without calcination: for then they ſhould retaine the taſte of the Simples, which lyeth in the ſalt, and much other vertue which the fire conſumes in calcination. It were a delicate thing to haue all our vegetable ſalts to retaine the taſte of the hearbs and ſimples, from whence they are drawne: as of wormewood, bitter; of ſorrell, ſowre; of licoris, ſweet, &c. There are in mine opinion, three ſeuerall wayes for it, although they be laborious. The one is by precipitation, when the iuyce or ſtrong decoction of any ſimple is precipitated by the addition of ſome appropriate liquor which will ſtrike downe all other parts in the iuyce or decoction; but the ſalt which is in it will not eaſily precipitate, but will remaine in the liquor, and muſt be ſeuered either by euaporation, or by roching. But in this worke we muſt make choyſe of ſuch a precipitator, as may not infect our ſalt with any ſtrange quality. Another way is to make an extract of the ſimple which we deſire to worke vpon, and when we haue made it ſo dry as it will be powdred, then powre vpon it pure ſpirit of wyne, which will diſſolue no ſalt, if it bee without phlegme. By this meanes through often repetitions of new infuſions, vntill the extract will yeeld no more tincture vnto the ſpirit of Wine, you ſhall finde the ſalt in the bottome, as a ſubſtance which the ſpirit of Wine will not worke vpon, nor diſſolue. A third way, as I conceiue, may be in manner of the working of ſalt-Peeter, by putrifying great quantities of the hearbs, vntill they become earth: and then by infuſions with water, to extract the ſalt, which will not putrifie with the hearb, but will remaine in the earth. The ſecond courſe

I haue tryed, the other wayes are very probable. In theſe ſalts doe lye the chiefe vertues of many ſimples, either for purging by ſtoole, or vrine, or for cleanſing, cooling, drying, ſtimulating, opening of obſtructions, attenuating of groſſe humors, aſtriction, corroboration, &c. according to the nature of the ſimples: whereas the other ſalts which are made by calcination, haue loſt theſe vertues by the violence of fire, and cannot be diſtinguiſhed the one from the other.

Niter is a volatill ſubſtance which doth dry and attenuate more then ſalt, & although it hath not ſo much aſtriction as Salt is ſaid to haue, yet it ſeemes to coole more then Salt, perhaps becauſe it is of thinner parts, and penetrates more, and that is the reaſon that it ſerues better for the diſſolution of Metals. In phyſicke we finde our Sal nitrum (which is a kinde of it) to coole the body mightily, and therefore vſed in Iuleps. Theſe niters alſo are apt to moue ſweat, eſpecially thoſe that are drawne artificially from mixed bodies, as from Boles, cordiall hearbs, Bones, hornes, Teeth, Clawes, Hooſes, &c. which are drawne by ſublimation. And theſe parts of animals are found to be very ſoueraign againſt venome and maligne humours. The reaſon of it I take to be, not onely the drying quality they haue, whereby they reſiſt corruption of humours, but alſo and principally by reaſon of their volatill ſalt or niter, whereby they moue ſweat, and expell from the center of the body. For all their ſalt is volatill, as may appeare by this, that you can neuer make any *lixiuium*, out of any of theſe animal medicines, by calcination, as you doe out of vegetables; their ſalt being altogether euaporated by the fire. This volatill ſalt being taken into our bodies, and actuated by our naturall heat, is commonly very Diaphoreticke: & this is it which makes our Bezoar ſtones,

contra ierua, vngula del Bado, and ſuppoſed Vnicornes horne to be in ſuch eſteeme.

Sal ammoniacum, is alſo a kinde of niter, and volatill, and ſo is Borax and Altincar: but theſe are commonly mixed with *Sal alkali*, and Vrin or Vinegar, and ſo made more fix. There is alſo a naturall Fix borax found in the Ile of *Lambay* neere *Dublin* in *Ireland*, which perhaps the Sea water hath fixt. Allum and Vitrioll are much alike, but that Vitrioll hath a garbe from Copper or yron. Theſe are very aſtringent, and without doubt cold, whatſoeuer hath beene held of them. The waters or phlegmes diſtilled from them, doe exceedingly coole in Iuleps, as *Quercitan* and *Claudius Dariot*, haue obſerued, and we alſo by daily experience doe finde true; by reaſon of the intenſe aciditie they haue, being diſtilled from their Terreſtriall parts. Alſo thoſe *acidula* which the Germans call Saurbrun, proceeding from theſe iuyces, are much vſed to quench the heate of feuers. It may be obiected, that they are corroſiues, and will eate into metall, and therefore muſt bee hot. But by the ſame reaſon, the iuyces of Limons, Barberies, Howſleeke, &c. ſhould be hot, for they will carue iron. To bite and eate as a Coroſiue, are not argumẹnts of heate, but of piercing. Wherefore *Hippocrates* ſaith, *Frigus vlceribus mordax*, and *frigus eſt principium deſtructiuum, vt calor generatiuum.* And therefore it is more probable that theſe corroſiues are more cold then hot. Theſe two minerall iuyces are not ſo readily diſſolued in water, as the other two, and will bee more eaſily precipitated by any oppoſite ſubſtance that is more familiar to water. I omit the ſeuerall ſorts of theſe concrete iuyces and their admixtures with other minerals, as impertinent to my purpoſe: wherefore I will ſhew ſome examples of each of them in naturall Springs.

In peſtis Alexic. Dariot de præparat. med. Tract. 2. cap. 23. 24.

Lib. de Humidorum vſu.

For.

For ſalt Springs, *Ioſephus a Coſta* tels vs of a rare Spring at a Farme neere Cuſco in Peru, which as it runs, turnes into very white ſalt, without any fire or Art, in great abundance. In Germany are many ſalt fountaines, at Luneburg, Stafford, Saltzburg, Aldondorf, Halſtat, &c. In Italy, *in agro Volaterano*, &c. In Cicily, at Solinantia, is a ſalt Well which is hot; and ſo are the Pegaſæi fontes in Caria. Alſo the fountaine by Medon in Træſen is both ſalt and hot. Our Wiches in Cheſhire are well knowne. There are alſo Riuers of ſalt water by the Caſpian ſtreights, and in Spaine, and Caria, and in Bactria, Ochus and Oxus. Alſo there are ſalt Lakes, as the Terentin Lake in Italy, the Lake betweene Strapela and Seburg (mentioned before) In Germany, three Lakes in Cicily, and beſides an infinite number in other Countries, the Lake of Lakes, the Sea. All which receiue their ſaltneſſe from Mynes of ſalt in the earth, which are very frequent and huge in bigneſſe, as may appeare by the Rocks of Salt in Bohemia, in monte Carpato, in Polonia, within two miles of Cracouia, in Heluetia, and Rhetia, where they haue no other ſalt but from the Rocke. As alſo by the Caſpian Straights, are great Rocks of Salt. But *Marcus Paulus Venetus*, tels vs of a Rocke or Mountaine of Salt in *Thaican*, able to furniſh all the world with Salt. So that it is no maruaile that the Sea is ſalt, ſeeing it pierceth into the bowels of the earth, and diſcouereth many great Rockes of Salt which diſſolue in it. And this is the true cauſe of the ſaltneſſe of the Sea. The other cauſes alleadged for it, are very improbable. For whereas *Ariſtotle* and his followers attribute the ſaltneſſe of the Sea, to the euaporation of the freſh and ſweet parts of the water, by the Sunne, and to an aduſtion procured alſo thereby: I anſwer, that neither the one nor the other *Lib. 3.*

can breed a ſubſtance in the water, which was not there before. For qualities can breed no ſubſtance, and aduſtion is but a quality imprinted, and no ſubſtance. Neither can euaporation breed any, but onely diſcouer that which was in it before, by taking away the thin parts, and leauing the terreſtriall behinde. But we ſee the Sea-water to containe in it the ſubſtance of Salt, and moſt of the ſalt which we vſe is made of Sea water: and no man will deny that this Salt is differing from water in his ſubſtance and generation, being a diſtinct ſpecies in it ſelfe. And whereas they alledge for confirmation of their opinion, that vnder the torrid Zone, the Sea is more ſalt then in other parts, the Sunne exhaling more there, and making a greater aduſtion: I doubt it, both for the large and plentifull riuers which thoſe parts afford, beyond any other parts of the world, and alſo for that the Sea water there is not hot, neither are the beames of the Sunne ſo hot, but that men doe endure them: and therfore not likely to breede an aduſtion in the Sea water, which muſt firſt be hot, before it be aduſted. Alſo it may be that thoſe parts doe abound in rockes of Salt, as we reade of people in Affrica, called *Ammantes*, who make them Houſes of rock-ſalt, and Caſtles, as that in Sinu Geraico, which is fiue miles in compaſſe, and all of Salt: alſo the mountaine Oromenus in India is all of Salt. Moreouer if the Sunne be able to doe this in the Sea, which is alwaies in motion, whereby it alludes the force of the beames; why ſhould it not doe the like, and much more in ſtanding Lakes, as the Lemanus and ſuch like? They anſwer that Lakes are continually ſupplyed and fed with freſh water from Springs. But ſo is the Sea continually fed with freſh water, and in as large a proportion, *cæteris paribus*, as Lakes are. For as the Sea is not increaſed by the influx of freſh waters, no more are

Aliquid aquæ admixtum Ariſt. 2. Meteorol. cap 3.

diuers

diuers Lakes, but keepe the same fulnesse, and sometimes are lessened. And whereas they say that the vpper part of the Sea is more salt then the bottome, they speake against all reason, Salt being heauier then water, and against experience, as I haue shewed in the former chapter. Also *Aristotle* in some places confesseth it. But if any man will take the paines to vapour away 100. tunne if he will, of fresh water, I doe assure my selfe hee will not finde one graine of salt at the bottome, if it were not in the water before. This may be tried also in any distilled water, which we are sure can haue no Salt in it, (for Salt will not arise in distillation) and is as apt to yeeld Salt as any other water, if adustion or euaporation would breed it. Wherefore the saltnesse of the Sea is not from euaporation or adustion, but must needes proceed from rocks of salt in the earth, which the Sea doth wash, and dissolue much of it. And considering the great vse of Salt, both for other vses, and for generations, nature hath prouided enough of it, especially in the Sea, which is more fruitfull in that respect, then the Land. Wherefore *Venus* was called Αλιγενὴ : *Est Venus orta Mari.* *Meteor. 2. c. 3.*

Niter is seldome found in Bathes alone, but mixt with other minerals, which it dissolues, and infects the water withall. Yet wee reade of a nitrous Lake called Letis, neere Calestria in Macedonia, where they vse to make Niter, and vent it to all parts. So they doe at the Nitrarie in Egypt. Also the Lake Arethusa in Armenia, is full of Niter. At Menis in Phrygia is a Spring of nitrous water which is hot: also in Leonte is a hot nitrous Spring. *Bellonius* makes mention of a Nitrous fountaine neere Belba, and of abundance of Niter vpon a Plaine neere thereunto, which seemes to be that which *Pliny* cals Halmiraga. But he denieth that there is any Mine *Obseruat. l. 3. c. 76. 77.*

of

of Niter vnder the earth, but that all is bred out of the
Lib.5.c.7. ſoyle as an *efflorescens* of the earth: *Baccius* ſaith the ſame of Salt-peter. *Agricola* ſaith, that as the true Niter is gathered vpon the Playnes of Media aboue the earth, ſo is Salt-peter found aboue the earth in many
Lib.31.c.10. places of Saxony: That Niter is gathered vpon the Plaines of Media, are *Plinyes* owne words. *Exiguum fit apud Medos caneſcentibus ſiccitate connallibus.* So that it ſeemeth, his opinion was, that Niter is not bred in a Myne vnder the earth, as *Geſner* alſo ſaith, *Epiſt. lib. 3. pag. 134.* but in the earth it ſelfe, as the chiefe fatneſſe it hath to further generations. And ſeeing earth is the mother of all Terreſtriall bodies, it is not left vnfurniſhed with thoſe minerall iuyces, nor ought elſe that is requiſite for the production of ſpecies: It hath beene obſerued by ſome, that nitrous water is the beſt ſoyle for ground, and brings all Plants to perfection farre ſooner then any other dung, and therefore the Egyptians wa-
Martial. ter their Coleworts with Nitrous water, *Nitroſa viridis braſſica fiet aqua.* Our Salt-peter men doe finde, that if any fat earth be couered from raine and ſunne, ſo as it ſpendeth not his ſtrength in producing of Hearbs or Graſſe, it will breede plenty of Salt-peter, otherwiſe it will yeeld none. The difference betweene Salt-peter, and the ancient Niter, appeares in this, that a pound of Niter being burnt, will leaue foure ounces of aſhes; Salt-peter will leaue none. Salt-peter is actually ſo cold, as being diſſolued in water, it is vſed in Rome and Naples to coole their Wine, and doth it as well as yce or ſnow. Alſo we vſe it inwardly in cooling Iuleps, and therefore it ſeemes alſo to be potentially cold, as *Bellonius* iudgeth.

Now I come to Allum (*Indignum vox ipſa iubet renouare dolorem*) the greateſt debter I haue, and I the beſt

beſt benefactor to it, as ſhall appeare when I ſhall think fit to publiſh the Artifice thereof. In Illua, a mile from Rio, is an Allum fountaine: alſo there are diuers in Agro Senenſi, Volaterano Lucenſie, in Italy, *Balneum de villa* is full of Allum: and with vs in Shropſhire at Okenyate, are Allum ſprings, whereof the Dyers of Shrewesbury make vſe in ſtead of Allum. As for allum Mynes, they are frequent almoſt in all Countries, but the chiefeſt that are wrought, are at Capſylar in Thracia, at Tolpha neere Ciuita Vecchia in Italy, at Commatow by Auſſig in Germany, and with vs in Yorkeſhire. In Ireland there haue beene allum workes neere to *Armagh*, as *Thurmiſer* reports: alſo at Metelin in Spaine, at Mazaron neere Carthage, at Helleſpont, Maſſa, Montrond, Piambin, Volterra, Campiglia, &c. as *Beringaccio Sieneſe* reports. Alſo there are diuers earths yeelding allum, as at Guyder in Carnaruanſhire, at Camfurt in Dorſetſhire, and in the Iſle of Wight. But I will contract my ſelfe for allum, and come to Vitriol.

Pyrotechnic. l. 2. c. 6.

Vitriol, as I haue ſaid before, doth participate much with allum in the manner of ſhooting or roching, which is *in glebas*, in the hard diſſolution and eaſie congelation, in their ariſing in bullas being burnt, and in their precipitation: in ſo much as it is probable, that the baſis of Vitriol, is nothing but allum. It is found in minerall waters of two ſorts. The one, where the very body and ſubſtance is diſſolued: as in Cyprus, which *Galen* deſcribes, where the water is greene: alſo at Smolnicium in Hungary, in Tranſiluania *ad Carpatum montem*, at Nenſola, &c. In which places Copper is ordinarily made out of iron by infuſing it in theſe waters. I will not determine whether this be tranſmutation of one ſpecies into another, as ſome doe hold, or rather a precipitation of the Copper which was formerly

Simp. med. facul. l. 9 c. 61.

Libau. in Syntag. 3. part. l. 7. Item ſingularium part. 1.

dissolued in the water by meanes of the sharpe Vitriol; which meeting with Iron, corrodes it, and imbibeth it, rather then the Copper, and so lets the Copper fall, and imbraceth the Iron in place of it. We daily see the like in Aqua fortis, which hauing imbibed one metall, will readily embrace another that is more familiar to it, and let fall the first. So allum or Coppresse water hauing some strong Lixiuium of Tartar or other calcind salt put to it, the allum or Coppresse will presently fall to the bottome, and precipitate and giue place to the Lixiuium, as a thing more familiar to water, and of more easie dissolution. But as I said, I will not determine this question, because it is not much pertinent to our businesse. Yet I will not omit the iudgement of *Lazarus Ercker* the Emperours chiefe Mine-master in the Kingdome of Bohemia, who professeth that he was long of this opinion, but altered it vpon this reason; That by exact proofe hee found more Copper stricken downe this way by Iron, then the water before did containe, and with the Copper some Siluer. The other kinde of Vitriol water is, where not the body and substance of Vitriol is dissolued, but the spirit, or vapour, or quality communicated to the water: of this sort are our Vitriol Baths for the most part. And these are in themselues wholsome, and are sowre, if the Vitriol be predominant. Such are most of our *Acidulæ*; whereof we haue many in *Viterbio & Volaterano*, *Balneum ad morbum dictum*, Saurbrun by Franckford, *ad oderam*, &c. There are sowre waters also from Allum, but milder, also from Sulphur, whose spirit or vapour being burnt, is little differing from the spirit of Vitriol, but somewhat fatter. But the most part of our *Acidulæ* are from Vitriol. This sowre spirit of Allum, Vitriol, or Sulphur, *Libauius* iudgeth with *Thomas Iordanus* to be in the terre-

Lib. 3. Von. Kupffer ertz.

Io. Baubinus de thermis l. 2. c. 2.

De iudicio aqu. miner. p. 2. c. 36.

striall

ſtriall parts of theſe minerals, becauſe it goeth not away by boyling or diſtillation, and therefore to be communicated with water by the corporall ſubſtance or iuyce of them. But that holds not in minerall ſpirits which are heauier then water, as may appeare by euaporation of any water made ſowre with ſpirit of Vitriol or Sulphur, where, after long euaporation, that which remaines will be more ſowre then before euaporation. So it is alſo in Vinegar, being a vegetable iuyce. The ſpirit of wine doth certainly ariſe firſt in diſtillation, and the firſt is the beſt, being more volatill then the vapour of water. But this *ſpiritus acetoſus* which is in Sulphur, Allum, Vitriol, and Vinegar, ariſeth laſt; and the more you diſtill away from it, the ſharper it ariſeth, and the ſowrer is that which remaineth. Thus much for Vitriol and concrete iuyces.

Cap. 8.

Of minerall ſpirits. Quickſiluer, Sulphur or Brimſtone, Arſenick, with his kindes, Cadmia.

A Fift kinde of minerals are called ſpirits; theſe are volatill in the fire, and haue ingreſſion into metals, but no metall in fuſion. Theſe are Quickſiluer, Sulphur, Arſenick, Cadmia, Ruſma, &c. All which being volatill will eaſily ſublime, and being mixed with metals, as Cadmia is ordinarily to make Braſſe, will alter the colour of the metall, and make it leſſe fuſible, and leſſe malleable. I will briefely run ouer the examples of theſe and their vertues or qualities, being more obſcure, and in our Bathes leſſe vſefull then the former, and more rare.

Quickſiluer was not well knowne to *Galen*, for he confeſ. *Simpl. med. facult. l. 9. c. 59.*

confeſſeth that hee had no experience of it, and did thinke it to be meerely artificiall, and not naturally bred in the earth. *Dioſcorides* makes no mention of the temperature of it, but holds it to be a pernitious venome, and to fret the entrayles: although *Mathiolus* affirmes that it is ſafely giuen to women to further their deliuerance, and we find it ſo by often experience, both in that cauſe, and in Wormes, and in the French diſeaſe and Leproſies, if it be skilfully prepared, and with iudgment adminiſtred. *Fallopius* holds it to be one of the miracles of nature. Thoſe that take vpon them to determine of the qualities of it, are much diſtracted; ſome reckoning it to be hot and dry, and ſome cold and moiſt; and both in a high degree. But in this account they conſider not the qualities of the ingredients in the preparation; whether it be ſublim'd or precipitated. For my part I know not how to reduce it to the Elementary qualities: neither am I aſhamed of mine ignorance in it, ſeeing no man hitherto hath giuen true ſatisfaction herein. And if it be true that the elements doe not concurre to the generation of mixt bodies, (as I ſhall ſhew, *cap.* 11.) we need not maruaile if we finde them not, where they be not. But for our owne vſe, where reaſon failes vs, let vs be guided by experience. We finde by experience, that it cuts, attenuates, penetrates, melts, reſolues, purges both *ad centrum & à centro*, heats, cooles, &c. and is a tranſcendent beyond our rules of Philoſophie, and a monſter in nature, as *Renodæus* ſaith. For our purpoſe it is enough to know whether it will impart any qualitie to water; which *Fallopius*, *Baccius*, *Solinander*, *Bauhinus*, and *Felix Platerus* doe acknowledge. But it giues no taſte to it, neither haue we many examples of Baths which containe it. In Serra Morena in Spaine, neare the village Almedien, is a Caue, where are many Wels, in-

Vidus Vidius curat. generatim p. 2. ſect. 2, l. 3. c. 13.
Fallopius de metallis c. 37.

fected

fected (as is thought) with Quickſiluer, becauſe much of that minerall is extracted from thence, out of a red ſtone called *Minium nativum*. About fifty miles from thence in Valentiola, there is another fountaine called La Naua, of a ſharpe taſte, and held to proceede from Quickſiluer, and theſe waters are found wholeſome. So are the waters at Almagra and Toletum, and others by the riuer Minius, which are hot. There are many venomous ſprings attributed to Quickſiluer, as the red fountaine in Ethiopia, others in Boetia, Cæa in Trigloditis, Stix in Archadia, Stix in Theſſalia, Licus in Sicilia, &c. which perhaps are from other minerals, ſeeing wee finde ſome from Quickſiluer to be wholſome. For mines of Quickſiluer, we reade of many in Bætica, Attica, Ionia, out of a ſtone which *Pliny* cals *vomica liquoris æternis*. In Germany at Landsberg, at Creucenachum, Schenbach, Baraum aboue Prage Kunningſtien, &c. In Scotland, three miles beyond Barwicke, I fonnd a red ſtone, which I take to be *minium nativum*, ſeeing *Agricola* makes mention of it in Scotland, but by a miſchance could not try it.

Sulpher attracts, contracts, reſolues, mollifies, diſcuſſes, whereby it ſhewes a manifeſt heate, though not intenſe, yet the fume of it is very ſoure, and therefore muſt coole and dry: and I perſwade my ſelfe that there is no better fume to correct venomous and infectious ayre, then this of Sulphur, or to remoue infections out of roomes, clothes, bedding, veſſels, &c. We muſt acknowledge differing parts in all compounded bodies; as Rubarb hath a purgatiue qualitie in the infuſion, and an aſtrictiue in the Terreſtriall ſubſtance, where the ſalt hath beene by infuſion extracted. The ſubſtance of Sulphur is very fat (*Sulphure nihil pinguius*) ſaith *Felix Platerus*) and this is the cauſe of his eaſie taking of

fire, and not any propinquity it hath with fire in the qualitie of heate: for if it were very hot, *Dioscorides* would not commend it *purulenta extussientibus*, the next dore to a Hectick. Also *Galen* saith, that fat things are moderately hot, and are rather nutriments then medicaments. Now for Sulphurious Bathes, they are very frequent, and if we should beleeue some, there are no hot Bathes, but participate with Sulphur, but they are deceiued, as shall appeare hereafter, when wee come to shew the true causes of the heate of Bathes. Neither are all sulphurious Bathes hot. *Gesner* reports of a Bath by Zurich, very cold, and yet sulphurious. *Agricola* of another by Buda in Pannonia. In Campania by the Leucogæan hils, are cold Springs full of Brimstone. Also there are hot Bathes without any shew of sulphur that can be discerned, as the Bathes of Petriolum in Italy, the Bathes Caldanellæ and *de Auinione in agro Senensi de Gratta in Viterbiensi, de aquis in pisanis collibus, Divi Iohannis in agro Lucensi in Alsatia*, another not farre from Geberſallerum, &c. All which are very hot, and yet giue no signe of Sulphur either by taste, or smell, or effects. And yet no doubt there are many Bathes hauing a Sulphurious smell from other minerals; as from Bitumen, Vitriol, Sandaracha, Allum, &c. which are hardly to be discerned (if at all) from Sulphur. So wee commonly say, if a house or a tree bee set on fire by lightning, that it smels of Brimstone, when there was no Brimstone there. Many things combusted, will yeeld a nidorous smell, not discernable after burning, what the things were. But there are diuers truely Sulphurious Baths which containe Sulphur, although not perfectly mixt with the water without some *medium*, but onely confused: for perfect Sulphur will not dissolue in water, no more then Bitumen. The spirit of Sulphur may bee

communi-

communicated to water, and so may the matter of Sulphur before it hath attained his perfect forme and consistence: otherwise it is onely confused with water, and alters it into a milky colour. *Sulphurea Nar albus aqua.* At Baia are diuers hot Sulphurious Baths, and euery where in Hetruria; in Sicily, *in Dioceſi Panormitana*; the Baths of Apono, as *Sauanarola Muntagnana*, and *Fallopius* auers, although *Iohn de dondis* denieth it; the Bath of Astrunum, of Callatura, S. Euphemie, Aquisgran, *Brigenſes thermæ in Valeſijs Heluetiorum, aqua ſancta in Picenis*, and an infinite number euery where. *Baccius* reckons our Baths of *Bathe* among Sulphurious Baths, from the relation of *Edward Carne* when he was Embassadour to *Iulius tertius*, and *Paulus quartus*. I will not deny some touch of Sulphur in them, seeing we finde among Bituminous coales, some which are called metall coales, with certaine yellow vaines which are Sulphur. But the proportion of Sulphur to Bitumen, is very little; and therefore I doe not hold them Sulphurious *à prædominio*. This is enough for Sulphur.

Concerning Arsenick, it is a venomous minerall, and therefore I neede speake nothing of the Bathes which proceede from it, but that wee take heed of them; It is likely that those venomous waters and vapours which kill suddenly, doe proceede from Arsenicke, as at Cicrum in Thracia, *fons Neptunius in Terracina*, at Peraut by Mompelier, *the Lake Auernus. The caue of Charon by Naples.* Vnder Arsenicke wee may comprehend Auripigmentum, Risagalum, Sandaracha, Rusma, &c. I heare of but one Mine of Rusma in Ciprus, from whence the Turkes haue it to take off hayre, and it doth it best of any thing knowne, as *Bellonius* and *Platerus* report, and I haue made tryall of it oftentimes: The former sorts of Arsenicke are found *in Mißia Helleſponti in*

Ponto,

Ponto, by the Riuer Hippanis, which is made bitter by it. In the leſſer Aſia, betweene Magneſia and Eupheſus in Carmania, &c. It is accounted to be extreame hot and putrifying.

Cadmia is either naturall or factitious: The naturall is often dangerous in Germany, as *Agricola* ſaith, eſpecially that which is liquid, which is a ſtrong corroſiue: the other is of the nature of Copper, moderately hot and clenſing, and eſpecially good to cleere the eyes, as Calaminaris and Tutia. It is found in Copper Mynes, and of it ſelfe in Cyprus, as *Galen* ſaith by the Citie Solos. Alſo in *Agro Senenſi, vicentino, Bergomenſi*, neere Como, where they make Braſſe with it. Vnder Mendip hils there is much of it. The Bathes of Saint *Gaſſian* doe participate with it, and *Cicero* his Bathes neere Baia. Alſo the Bath at Zurich in Heluetia, and Grotta in Viterbio.

Thus much for Spirits.

Cap. 9.

Of meane metals, or halfe metals. Biſmutum or Tinglaſſe. Antimony. Bell-metall.

A Sixt ſort I make to be meane metals, or halfe metals, which are minerall ſubſtances, hauing metalin fuſion, but are not malleable as metals are: and therefore being mixt with metals, doe make them brittle. Theſe are *Biſmutum*, or *plumbum cinereum*, Anthimony, Bell-metall, which *Gaber* cals *Magneſia*, in Dutch, *Speiſſ*. Calaem alſo may be reckoned among thoſe, which is a kinde of white metalin Cadmia, brought out of the Eaſt Indyes, which hath both metallin ingreſſion, and metallin fuſion, but not perfectly malleable. Theſe although

although they are more volatill then metall, yet by reason of their fusion into a King, are not so easily sublimd as the Spirits.

Bismutum is that wee call Tinglasse, differing both from Tin and Leade. *Candidius nigro, sed plumbo nigrius albo.* It was not knowne to the Ancients, and therefore we can say little of the qualities of it. It is found in England, and in Misnia, and at Sneberg in Germany, and in very few places else. I reade not of any waters that participate with it: neither can I say much of Antimony, but that *Dioscorides* saith it cooles, bindes, opens obstructions, &c. And *Galen*, that it dryeth and bindeth, and is good for the eyes, &c. But of the purging qualitie they write nothing, although we finde it to purge violently, both vpwards and downewards: whereupon wee may gather that all purging medicines are not hot, as I haue touched before. *Camden* saith there is a Mine of it in Cumberland: It is found in Italy, *in Thinni montibus, in Senensi agro* in the Countie of S. Flora, and in Germany in many places. But I reade of no waters that participate with it, vnlesse wee should iudge all purgatiue waters to be infected with it: as neere Ormus, *Purchas* writes of such a Spring which purgeth. *Sauonarola in Balneis Romandiolæ*, mentions a Spring at Meldula, which purgeth. Also *Balneum Tertutij in agro Pistoriensi, Fallopio*; also the sowre water of Mendich and Ponterbon doe purge choler, as *Rulandus* saith. At Nonesuch we haue also a purgatiue Spring, which may participate with Antimony or Niter, or both: But purgatiue waters are rare, vnlesse it be *ratione ponderis*, by the weight and quantity, and so any water may purge, and our Bath waters doe purge in that manner, and by the addition of Salt, which giues stimulation vnto it. This our Bath guides doe ordinarily prescribe to

parte 3 pag. 72.

ſuch as will be perſwaded by them, not knowing how it agreeth with their griefes, nor how it may doe hurt in many reſpects, as oftentimes it doth.

Bell-metall is thought to be a mixture of Tinne and Copper Oares, as *Kentman* iudgeth, and is found in our Tinne and Copper Mynes in Cornewall. I reade of no waters infected with it, nor of any vſe it hath in Phyſicke.

Cap. 10.

Of metals. Gold. Siluer. Iron. Copper. Tinne. Leade.

Fallop. de metallis cap. 10. Libau. de nat. metall. part 3. cap. 5.

THe ſeuenth and laſt ſort are metals, minerall ſubſtances, fuſible and malleable. Theſe are commonly diſtinguiſhed into perfect and imperfect; perfect, becauſe they haue leſſe impuritie or heterogenitie in them, as gold & Siluer. The reſt are called imperfect, becauſe they are full of impurities, and they are either hard or ſoft. Hard, as thoſe which will indure ignition before they melt, as iron and Copper: Soft, which will not, but melt at the firſt, as Tinne and Lead.

All theſe metals are found in his Maieſties dominions, and many of them I perſwade my ſelfe, might bee wrought to better profit, if our Smelters were skilfull, or were not hindered by ſiniſter reſpects. But eſpecially we abound in the imperfect metals more then enough to ſerue our owne vſe. And for the perfect metals, I haue ſeene both in Cornewall, and at Crayfordmuir in Scotland, perfect gold (which the Dutch call Gedigen) in grayns among Sparr. Alſo among other metals, it is ordinarily bred, as Iron, and Copper, and Tinne. But from Tinne it is hardly ſeparated without more waſte

of

of Tinne then the gold is worth. From Iron and Copper I see no reason but it might be separated with aduantage.

For siluer, there is much lost for want of taking it forth of Lead Oares. For whereas those Oares which are rich in siluer, are commonly hard of fusion; our minerall men either neglect those Oares, and worke them not, or else they mixe some small proportion of them with their poore Oares, which are easie of fusion, and so make the metall so poore, as it is not worth the refyning. Whereas if they were wrought by themselues, they would yeeld in siluer vpon euery tunne, some 20. ounces, some 40. some 60. some 80. more or lesse.

For Copper, whereas we fetch our Pinnes and Tags of Poynts from other Countries, yet no doubt wee might be furnished of our owne, both for these and other vses. We haue but one Copper worke that I heare of in all his Maiesties Dominions, and that is at Keswick in Comberland: but Copper Mynes are found in diuers other parts, as in Cornwall at Treuascus, and other places in Yorkeshire, Scotland, Ireland, &c. And no doubt, many are concealed, by reason they are Mynes Royall. If these were wrought, and wrought after a good manner, it is likely they would bring a good aduantage to his Maiesty, and to the Kingdomes.

For iron, wee haue the Oare in abundance, but it is pitty that so much good wood should be wasted vpon it for so bad iron; and yet the gold which it holds, is lost. Many haue propounded the melting of it with stone-coale, but perhaps they haue failed in their projects: yet this doth not proue the impossibilitie of it. And for the goodnesse of this metall, if it were rightly made, it would melt as readily as other metall, and would be tough, and not so brittle as it is, and would

not be so apt to rust. For these inconueniences happen to it for want of separation of the impurities which are bred with it.

For Tinne, wee haue as good as any in the world, although it is not wrought to the best aduantage. The Countries where it growes, are barren of wood, and they are faine to fetch it farre off. Now if it were wrought, as I know it may, by many experiments which I haue made vpon it, with stone-coale, there would bee much saued, and the wood might bee otherwise employed. The Tinne also would be as good as now it is, and the product not diminished.

For Lead, although for soft Oares the ordinary course of melting at Mendip and the Peake, may serue well, and much better then their Baling at Alendale in Hexamshire, and at Grasse in the Bishopricke of Duresme: yet for hard Oares (which are commonly rich in siluer) there might bee better courses taken, by common or proper Agents. Common agents are fire and water: proper are dissoluents or additaments. By fire they might amend their working, if they did roast their Oares well before melting, to breathe away volatill and combustible substances which are mixed with their Oares. By water, after calcination or rosting, they may separate all dissoluble iuyces, &c.

Dissoluents doe chiefely serue to separate the siluer or gold out of the Oares: as in the quicksiluer worke, or by Lyes of Niter, Allum, Salts, &c.

Additaments are also of great vse, whether they bee segregatory for separation of spirits, or meane metals from our Oares, and so to facilitate their fusion: or propugnatory to defend the Oares from consuming or vitrifying. Segregatory additaments are either such as are more easie of fusion then the Oare, and so draw the Oare into fusion with them, or such as will not melt at all, as

Geber

Geber saith, *Cuius intentio non sit fundi*: which keepes the Oare asunder from clodding, and giues it a greater heat, like fire in his bosome. By these meanes well applyed and vsed, all Lead Oares might be wrought, bee they neuer so stubborne, and none need bee neglected. Hitherto I haue digressed out of mine intended course, through the desire I haue to aduance minerall workes. Now I will returne to shew the nature and qualities of these metals, as I haue done of other minerals.

Gold of all metals is the most solid, and therefore the most heauie, as hauing few impurities or heterogeneall substances mixed with it. And therefore it is not subiect to corruption, as other metals are, neither will it loose any of his substance, either by fire or water, although it should be held in them a long time: so as it is an idle and vaine perswasion that many haue, who thinke by boyling Gold in broth, to get some strength from thence, and so to make the brothes more cordiall. The like I may say of putting Gold into Electuaries or Pils, vnlesse it be in case of Quicksiluer taken into the body, which the Gold by touch may gather to it, otherwise it goes out of the body as it came in, without any concoction or alteration, or diminution. And if it bee dissolued in strong water, it will be reduced againe to his metallin substance, without diminution, much lesse will it be dissolued without corrosiue Spirits, to make *aurum potabile*, as some doe vndertake. *Crollius* doth acknowledge, that there is but one *Menstruum* in the world that may doe it, and that he knowes not. But if we had it dissolued, we are yet vncertaine what the quality of it would be, or what vse to make of it in Physicke; onely because it looseth none of his substance, we know it can doe no hurt, and therefore we vse it for Cautoryes, and to quench it in Beere or Wine, &c. to warme it, or to giue it some astriction from the fire. *Fallopius* in these

Baccius lib. 6. cap. 8.

Basilica chimia. pag. 204.

De Thermis cap. 8.

regards disclaymes it in all minerall waters, as hee doth all other metals: and will not beleeue that any metall doth impart any qualitie vnto water. *Claudius* holds otherwise, and so doth *Baccius*, *Sauonarola*, *Montagnana*, *Venustus*, *Solinander*, and almost all that haue written of Bathes. For if we should exclude Metals, wee must likewise exclude Stones, and Bitumina and Sulphur, and almost all minerals, except concrete iuyces. For none of these, after they haue attayned to their full consistence, will of themselues dissolue in water, without the helpe of some concrete iuyce, as a medium to vnite them with the water. But before they haue their full consistence, whilst they are in *Solutis principijs*, as Earth, Iuyce, or Vapour, they may be communicated with water. Gold is so sparingly bred in the bowels of the earth, as in that respect it can hardly furnish a perpetuall Spring with any quality from it; yet some Bathes are held to participate with Gold, as *Ficuncellenses*, *Fabariæ*, *Piperinæ*, *de Grotta in Viterbio*: *Sancti Cassiani de Buxo*, *&c.*

In ingressu ad infermos, pag. 373.

Siluer comes next in puritie to Gold, but is inferiour vnto it, as appeares by the dissolution of it, and by the blew tincture which it yeelds, and by the fouling of the fingers, &c. For the qualities of it, there is not much discouered. But as all other things of price are superstitiously accounted cordiall, so is this, especially in hot and moyst distempers of the heart: for it is esteemed to bee cold, and dry, and astringent, and yet emollient. Wee haue no Bathes which doe manifestly participate with it: perhaps, by reason, nature doth not produce it insufficient quantitie to infect waters. *Iohn Bauhinus* thinkes there may be Siluer in the Bathes at Boll: because hee saith there was a Pyritis or Marchesit examined by Doctor *Cadner*, and out of fiftie pound weight of it, hee drew two drams of siluer: a very small proportion to

Theod. Tabernimontanus. p. 2 cap. 49.

ground

ground his opinion vpon.

Iron is the moſt impure of all metals, as wee haue it wrought, and will hardly melt as metals ſhould doe, but with additaments and fluſſes. Neither is it ſo malleable, and ductible as other metals are, by reaſon of his many impurities. Yet we ſee that at Damaſco they worke and refine it in ſuch ſort, as it will melt at a Lampe, and is ſo tough, as it will hardly breake. And this is not by reaſon of any eſpeciall Myne differing from other iron Mynes, for they haue no Mynes of iron neere to Damaſcus, as *Bellonius* reports, but haue it brought thither from diuers other places, onely their art in working and purifying it, is beyond ours. So the Spaniſh Steele and iron is purer then ours, and wee doe eſteeme of Bilbo-blades beyond others which are quenched in the Riuer Bilbilis: as *Turnus* his Sword in *Virgil* was quenched in the Riuer Styx.

Enſem quem Dauno ignipotens Deus ipſe parenti Ænead 12.
Fecerat, & Stygia candentem extinxerat unda.

But the hardning of Steele lyeth not in this point; other waters no doubt may ſerue as well. But I perſwade my ſelfe that our iron might be made much purer, and perhaps ſome gold extracted from it which it holds.

Concerning the temperature of Iron and Steele, *Galen* reckons it among earth, and therefore it muſt bee cold. *Minardus* is abſolutely of that opinion, and ſo are moſt of our Phyſitians. Onely *Fallopius* holds it to be hot, becauſe *Scribonius Largus* preſcribes it in vlcers of the bladder, which it doth cure, not in regard of heating, but drying; for it dryeth and bindeth much, and therefore by *Galens* rule it muſt be cold. *Aſtringentia omnia frigida.* I haue obſerued in Iron and Steele

Simpl. lib. 9.

Libs 16 Epiſt. 5. De metallis cap. 20.

simpl. lib. 4. c. 7.

Steele two distinct qualities, The one opening, or deopilatiue; the other astringent. The opening quality lyeth in a volatill Salt or Niter, which it is full of, the astringent qualitie in the Crocus, or Terrestriall part. These two substances are thus discerned and seuered. Take of the fylings of Steele or Iron, and cast it into the flame of a candle, and you shall see it to burne like Saltpeter or Rosin. Take these fylings, and infuse them three or foure times in Water or Wine, as wee vse to make our Chalibeat Wines, till the water or wine haue dissolued all this salt, and then dry it and cast it into the flame, and it shall not burne, but the liquor will haue a strong taste from this Salt. And this is it which opens obstructions. The astringent qualitie lyeth in the Terrestriall substance, as is euident, after either, by infusions, or by calcination, the volutill salt is departed from it, that which remaines, is very astringent, and stayeth all manner of fluxes, &c.

Concerning Bathes participating with Iron, we haue too many examples of them for *Fallopius* to contradict. We may let him inioy his opinion of the *Calderiana, Veronensia & Villensia Lucensia*, although it bee against the iudgement of all other who haue written of them, and it is hard for him to bee confident in a negatiue. Wee haue examples more then enough to proue the qualitie of Iron in our minerall waters. *Balneum Reginæ in agro Pisano*, is actually hot, and from iron. So is *Balneum Sancti Cassiani in agro Senensi:* So is *Balneum Ficuncellæ, de Russellis, Bora in agro. Florent. Brandulæ in agro Regiensi, Visicatoriæ in Tuscia, Isenbrun* by Leige, Forgense in Normandy: the Spa water, Tunbridge water: Bristoll water by S. *Vincents* Rocke: all which, some being hot, and some cold, participate with Iron, as may be proued, not onely by the consent of all writers,

Solinander, pag 193. Venustius, pag. 159. Baccius lib. 6. cap. 3. Sauonarola. Renodæus pag. 305.

writers, which haue made mention of them, but by the Mynes from whence they come, or by their taſte, or by their vertues.

Copper comes neereſt to the nature of Iron, but is more pure, and more eaſie of fuſion, and will bee almoſt all conuerted into Vitrioll. They are conuertible the one into the other, as I haue ſhewed out of *Erker*, in Vitrioll. And by the practiſe at Commataw and Smolnicium. The like alſo hath beene ſhewed in Cornewall, at the Confluence by Maſter *Ruſſell*. *Ariſtotle* alſo tels of a Copper Myne in Thalia, an Iland of the Tyrrhen Sea, which being wrought out, turned to an iron Myne: in this ſimilitude of nature, we cannot but iudge that there is a ſimilitude in qualities, and that Iron being cold, Copper cannot be hot. Temperate it may be, becauſe leſſe aſtringent then Iron, and more cleanſing: *Rhaſis* ſaith that it purgeth like a Catharticum, & in his Continent, preſcribes it to purge water in dropſies. Another argument that all purgatiues are not hot; It dryeth exceedingly, and attenuates and digeſts. Wee haue diuers waters which participate with it, which if they be pure from Copper it ſelfe, are very ſafe and wholeſome: but if they be foule, and proceede from the excrements of Copper, they are not wholeſome to drinke. *Balnea Cellenſia ſeu ferina in Martiana Silua*, doe conſiſt of Copper and Allum. The Bath of Fabaria in Rhetia, of Copper and Gold. *Aqua de Grotta in agro Viterbienſi*, is full of Copper; ſo is *Aqua Iaſielli*, *Balneum Leucenſe in Valeſiis*: *Marcus Paulus Venetus*, tels of a greeniſh fountaine in Perſia, which purgeth exceedingly, and is held to come from Copper.

Libau. de nat. metall. c. 10.

Tinne and Lead are two of our Staple commodities which our Country yeelds plentifully, not onely for our owne vſe, but to ſupply other Nations. Tinne is bred in

Cornwall, and part of Deuonshire, and in the Isles of Silly, which from thence were called *Cassiterides*. It is melted out of little blacke stones, which the Dutch call *Zwitter*, with great charge, because they cannot melt it, but with wood coales, which is brought them farre off, and they are faine to runne it ouer two or three times, before they can get out all the Tinne, and yet much of it is wasted in the blast. I doubt not but it might bee done with Sea-Coale, if they knew the Artifice, and with as great a product of Tinne. There is both siluer & gold found in it, but without wasting of the Tinne. We know no meanes to seuer it. It is in qualitie cold and dry, and yet moues sweat abundantly, as I haue proued.

Lead is melted commonly out of an Oare common to Siluer and Lead, as *Pliny* saith, called *Galena*. And although *Agricola* saith of the villachar Lead, that it holds no Siluer, and therefore fittest for assayes; yet *Lazarus Ercker* contradicts it out of his owne experience. Our Countrie abounds with it euery where, especially at the Peake in Darbishire, and at Mendip in Sommersetshire; Wales also and Cornwall, and Deuon, are full of it, and so is Yorkeshire and Cumberland. The qualities of it are cold and dry. But for these two metals, we finde no waters which are infected with them. In Lorayne, they haue Bathes called *Plumbaria*, which some thinke by reason of the name, to proceede from Lead: but *Iohn Bauhinus* thinkes they should bee called *plumiers*, as *Pictorius* writes it from the French word *plumer*, *à deplumando*, because they are so hot, as they vse to scald fowles in them, to take off their feathers.

Pag. 901

Thus much for metals, and all other sorts of Minerals, with their seuerall Natures and Bathes infected with any of them. As for mixed Bodies, and flores, and recrements, &c. they are to be referred to the simple bodies

dies from whence they proceede: As *Tutia, Pompholix: Minium, Ceruſſa, Sublimatum, Præcipitatum, &c.*

Cap. II.

Of the generation of metals in the earth. Their ſeminary ſpirit. That it is not from the Elements:

NOw I muſt ſhew the generation of theſe minerals in the bowels of the earth, which of neceſſity wee muſt vnderſtand, before wee can ſhew the reaſons how minerall waters receiue either their actuall heat, or their vertues. *Fallop. de metallis cap. 11. Libauius de nat: metal. cap. 12.*

Some haue imagined that metals and minerals were created perfect at the firſt, ſeeing there appeares not any ſeede of them manifeſtly, as doth of Animals and Vegetables; and ſeeing their ſubſtances are not ſo fluxible, but more firme and permanent. But as they are ſubiect to corruption in time, by reaſon of many impurities, and differing parts in them, ſo they had need to be repaired by generation.

It appeares in *Geneſis*, that Plants were not created perfect at firſt, but onely in their Seminaries: for *Moſes*, Cap. 2. giues a reaſon why Plants were not come forth of the earth, *ſcil.* becauſe (as *Tremelius* tranſlates it) there had as yet neither any raine fallen, nor any dew aſcended from the earth, whereby they might bee produced and nouriſhed: The like we may iudge of mineralls, that they were not at firſt created perfect, but diſpoſed of in ſuch ſort, as they ſhould perpetuate themſelues in their ſeuerall kindes. Wherefore it hath euer beene a receiued *Axiome*, among the beſt Philoſophers, that minerals are generated, and experience hath confirmed it in all kindes. Our Salt-peter men finde that *Agricola de ortu & cauſis Subt. lib. 5. c. 1.*

when they haue extracted Salt-peter out of a floore of earth one yeare, within three or foure yeares after, they finde more Salt-peter generated there, and doe worke it ouer againe. The like is obserued in Allum and Copperasse.

As for metals, our Tinners in Cornewall haue experience of Pits which haue beene filled vp with earth after they haue wrought out all the Tinne they could finde in them; and within thirty yeares they haue opened them againe, and found more Tinne generated. The like hath beene obserued in Iron, as *Gandentius Merula* reports of *Ilua*, an Iland in the Adriaticke Sea, vnder the Venetians, where the Iron breedes continually as fast as they can worke it, which is confirmed also by *Agricola* and *Baccius*: and by *Virgil*, who saith of it, *Ilua inexhaustis Chalybum generosa metallis*. The like we reade of at Saga *in Lygijs*, where they dig ouer their Iron Mynes euery tenth yeare. *Iohn Mathesius* giues vs examples, almost of all sorts of minerals and metals, which he hath obserued to grow and regenerate. The like examples you may finde in *Leonardus Thurneisserus*. *Erastus* affirmes that hee did see in *S. Ioachims* dale, siluer growne vpon a beame of wood, which was placed in the pit to support the workes: and when it was rotten, the workemen comming to set new timber in the place, found the siluer sticking to the old beame. Also he reports that in Germany, there hath beene vnripe and vnconcocted siluer found in Mynes, which the best workemen affirmed, would become perfect siluer in thirty yeares. The like *Modestinus Fachius*, and *Mathesius* affirme of vnripe and liquid siluer; which when the workemen finde, they vse to say, *We are come too soone*. But I need not produce any more proofes for this purpose, as I could out of *Agricola* and *Libauius*, and others, seeing

Lib. 3. c. 19.

In Sarept. concio. 3. 11. &c.

In Alchimia magna. De metallis pag. 17. & 19.

Von probierung der ertze. In Sarepta.

seeing our best Philosophers, both ancient and moderne, doe acknowledge that all minerals are generated. The manner of generation of minerals and metals, is the same in all, as is agreed vpon both by *Plato* and *Aristotle*, and *Theophrastus*. *Sebast. Foxius l. 3. c. 6. Severinus c. 8. p. 125.*

And as the manner of generation of minerals is alike in all, so it differs from the generation of animate bodies, whether animals or vegetables, in this, that hauing no seede, they haue no power or instinct of producing other indiuiduals, but haue their species perpetuated *per virtutem seu spiritum semini analogum*, by a spirituall substance proportionable to seede, which is not resident in euery indiuiduall, as it is in animals and Plants, which *Moses* saith haue their seeds in themselues, but in their proper wombes. This is the iudgement of *Petrus Severinus*, howsoeuer he doth obscure it by his Platonicall grandiloquence. And as there is not *Vacuum in Corporibus*, so much lesse in *Speciebus*. For that the Species are perpetuated by new generations, is most certaine, and proued before: that it is not out of the seeds of indiuiduals, is euident by this, that if minerals doe not assimulate nourishment by attraction, retention, concoction, expulsion, &c. for the maintenance of their owne indiuiduall bodies, much lesse are they able to breede a superfluitie of nourishment for seede. And how can they attract and concoct nourishment, and expell excrements, which haue no veines nor fibres, nor any distinct parts to performe these Offices withall? Moreouer they are not increased as Plants are, by nourishment, whereas the parts already generated, are extended in all proportions by the ingression of nutriment, which fils and enlarges them: but onely are augmented externally vpon the superficies, by superaddition of new matter concocted by the same vertue & spirit, into the same Species. *Cæsalpinus de metal. lib. 1. c. 2. Cap. 2.* *Erast. disput. part 2 p. 262.*

Thus much for the manner of all minerall generations, which is not much controuerted: the chiefe difference is about the efficient and the matter. About the efficient cause of generations (for wee must handle them all together) there are diuers opinions, as there are diuers causes which concurre to all generations of animals, vegetables, or minerals. But there must be one principall efficient cause, to giue the forme to all Species, as there are other adiuuant and attending causes. The principall cause and agent in this worke, is by most attributed to the influence of the Planets, especially to the Sunne, who either by his light, or by his heat doth frame the species of all things, and so of minerals, but chiefely in regard of his heat. This heat working vpon apt matter, is thought to produce the seuerall species which wee see. As for the motion of the Planets, it is certaine that they moue continually in a constant order, and the world could not subsist as it doth without it: so as it may bee *causa sine qua non:* a very remote cause, as there may be a hundred moe causes of that nature. So likewise the light, which the Peripatetickes make the instrument of cœlestiall effects, can doe as little to the furtherance of generations, seeing they proceed as well by night as by day: and for minerals, it is perpetuall night with them, the density of the earth and rocks not suffering the light to passe. Wherefore they insist chiefely vpon the heat of the Sunne. But *Moses* tels vs that Plants were created with their seedes in themselues vpon the third day, before the Planets, which were not created till the fourth day; to shew vs that Plants and terrestiall substances depend not vpon Planets for their generations, nor for their vertues, but haue the principall causes of them in themselues. The same wee may iudge of minerals, being terrestriall substances, and propagated by seeds,

Dorn. physica Geneſis.

seeds, as Plants are, and likely to bee created vpon the same day with Plants, seeing there is no other mention of their creation in *Moses*.

Now for the heat of the Sunne, no doubt it is an vniuersall fosterer of all inferiour substances: but that it should beget particular Species, is very improbable. The heat of the Sunne is no more apt to breed a Nettle, then a Dock, Brimstone then Salt, &c. For it cannot giue the essence to any thing: heat being onely a quality which can breed no substance, and such a quality as can onely segregate heterogeneall substances, and thereby congregate homogeneall. Whereas in all generations there must be a further power and vertue, to proportion the Elements fit for euery Species (if they will haue all things made of the Elements) and to bring the Species from a potentiall being to an actuall, giuing to euery thing his proper shape, quantity, colour, smell, taste, &c. and to vnite them, which before were of different natures. It must bee an internall and domesticall agent, and efficient cause, which must performe this: and such a one as is not common to all Species alike, but proper to that which it produceth: otherwise there would be no distinction of Species. And therefore *Moses* saith of Plants, that they haue their seeds in themselues, according to their seuerall kindes. Neither can any externall cause giue an essentiall forme to any thing, which forme must bee αὐτόφυη, inbred in the thing it selfe, and not aduentitious. And therefore *Scaliger* saith, *Formæ, non soliseſt quantitatis terminare*, and *Aristotle*, *calore natura vtitur tanquam ministro aut instrumento, non tanquam opifice aut legislatore*. Wherefore we will grant the Sunne to be an adiuuant cause, and by his heat to foster and cherish inferiour generations: but not to be a principall and begetting cause. And so *Zabarella* doth mollifie

Gal. de Mares.

De calore.

mollifie the harſhneſſe of the former opinion: and doth acknowledge that the Sunne doth further generations onely as an inſtrument of another ſuperiour power, whereby in minerals it may make the matter more apt to receiue the forme, but it makes no minerals, no more then it makes bloud in our bodies.

Others make the elements to be the principall cauſes of all ſpecies by their qualities. For the matter of the Elements, being a paſſiue matter, cannot bee an efficient cauſe of generations. Theſe qualities muſt bee heat or cold: for the other two are paſſiue, and attend rather vpon the matter of generations, then vpon the efficient. Fire therefore by his heat is thought of all the Elements to haue the greateſt hand in all generations, being moſt actiue and ſuperiour to all the reſt. This is he that muſt aſſemble the reſt of the Elements together, for the generation of euery Species, and ranke them in due order, proportion, weight, meaſure, &c. This is he that muſt reconcile the differences which are in their natures, and bring them to vnion. This muſt attract nouriſhment, and preſcribe the quantities, dimenſions, parts, figures, colours, taſts, ſauours, &c. of euery thing. A large Prouince he hath to gouerne, with one naked and ſimple quality, which can haue but one ſimple motion. *Simplicibus corporibus ſimplices tantùm motus congruunt.* Heat can but heat, and the effects of this heat are by ſeparation of different ſubſtances, τὰ ἀλοφύλων to congregate thoſe that are alike, τὰ ὁμόφυλα: But in this worke we make heat to vnite differing ſubſtances: for all generation is of differing ſubſtances vnited into one. Againe, fire hauing but one quality to worke withall, whereby he muſt vnite the other three Elements, what ſhall bring and vnite fire vnto them? This muſt be another power ſuperiour to them all, for wee muſt not imagine

imagine that they meete by chance as trauellers doe. And therefore *Aristotle* explodes this efficient of fire, and attributes it to the formes of naturall things. 1 *De anime* *Item* 2. *cap.* 4.

As for cold in the other elements, it is farre more vnlikely then heat, to performe these offices, being rather a distractiue, then a generatiue quality, and is not called in by any Author to this work, before the Species haue receiued his forme by heat: and then it is admitted only for consolidation, but how iustly, it is doubtfull: for heat doth consolidate as well as cold, by drying vp moysture. But we will not grant this to either of them, as principall Agents, but as they are instruments attending the formes of naturall things.

The Alchymists make Sulphur to bee the principall efficient of all minerals, especially of metals, and Mercury the matter. If they meane common Sulphur and Mercury, which are perfect Species in their kindes, they are much deceiued, and this opinion is sufficiently confuted by all that oppugne them. But it seemes they vnderstand some parts in the seminary of metals which haue some analogye with these: and so their opinion may be allowed. For the spirit, which is the efficient in these generations, doth reside in a materiall substance, which may be resembled to Sulphur or Oyle, as some other part may be resembled to Mercury. For all generations are framed of different parts vnited by this Spirit. Thus much of the different opinions concerning the efficient of all generations, and in particular of minerals. The matter whereof minerals are bred, is attributed chiefely to the Elements, as the generall matter of all animate and inanimate bodies: insomuch as both the heauens, and the very soules of men are made to proceed from the Elements.

Concerning the heauens, it hath beene the ancient opinion of the Platonicks, Pythagoreans, and Epicu-

Trismigistus in Asclepio cap. 1. Plato. In Timeo in Dialogo de natura.

ræans, that not onely these inferiour bodies, but also the cœlestiall, haue beene framed out of the Elements. *Plato* speaking of the heauens, saith, *Diuini decoris ratio postulabat talem fieri mundum, qui & visum pateretur & tactum: Sine igne videri nil potest, sine solido nil tangi: solidum sine terra nihil.* Wherefore holding the heauens to be visible and solid, they must bee made of the Elements. The Pythagoreans, and the Brachmanni of India held the same opinion of the heauens: where *Apollonius Tianæus* was instructed in all the Pythagorean doctrine, as *Philostratus* reports. The Epicureans also were of the same opinion, as appeares in *Virgil*, where he brings in *Silenus*, one of that sect, and one of *Bacchus* his crew, singing in this manner.

In vita Apollonei.

Egloga 6.

Namque canebat, vti magnum per inane coacta
Semina, terrarumque, animæque marisque fuissent,
Et liquidi simul ignis: vt his exordia primis
Omnia, & ipse tener mundi concreverit orbis.

Silenus sung, how through the Chaos vast,
The seeds were set of Earth, of Ayre, of Seas,
Of purest fire: how out of these at last,
All things haue sprung. and also out of these
The infant world was moulded.

De sacra Philosoph. cap. 51.

Of this opinion also was *Lucretius*, *Philo Iudæus*, *Valesius*, *&c.* although *Valesius* doth make more pure Elements for the heauens then ours are. *Aristotle* forsooke his Master *Plato* in this point, and frames the heauens of a quinteſſentiall substance.

But howsoeuer the heauens may participate with elementary qualities, and bee subiect to generation and corruption in their parts: yet mee thinkes they should

exempt

exempt our ſoules from this originall, and not make them out of the fragments of the Elements.

Scaliger inueighs againſt *Alexander Aphrodienſis*, for this opinion, and ſaith that hee hath poyſoned our philoſophy herein: *Venenauit hanc philoſophiæ partem.* So both he and others deriue the ſenſe, motion, vnderſtanding, growth, and the naturall faculties of our ſoules, and the peculiar properties of euery thing, vnto this originall, *turpiſſimo errore*, as *Seuerinus* ſaith. And *Scaliger* in another place concerning this: *De intellectu & ratione ipſaque anima quæ contaminarint iſtæ nebulæ Aphrodiſienſes, & pudet dicere & piget meminiſſe.* I am aſhamed to ſpeake, and grieued to thinke how this *Aphrodiſienſis* hath polluted our reaſon and vnderſtanding, and our very ſoules with his foggy doctrine, in aſcribing all theſe vnto the Elements. By the ſame reaſon they may aſcribe the barking of Dogges, the ſinging of Birds, the laughing and ſpeech of men, to the Elements. Their opinion is more probable, which hold, *animam ex traduce*, and to bee communicated as one light to another: as *Timoth. Bright* proues in *Phiſicam Scribonij*, and not to aſcribe it to the Elements, nor to miracles, or new creations. But there is farre more reaſon to deriue from the Elements, the taſtes, colours, ſmels, figures, numbers, quantities, orders, dimenſions, &c. which appeare more in corporall ſubſtances, and yet theſe are not from the Elements. For how can they giue theſe affections to other things, when they haue them not themſelues? *Si non eſt ab elementis guſtare, quare ſit guſtari?* What taſt haue any of the Elements? Fire or heat which is the moſt actiue Element, hath none. And whereas it is thought, that bitterneſſe proceeds from heat, wee finde that many ſharpe and tart fruits, being alſo very bitter before they are ripe, (as

Cap. de mixtione

Oliues for example) yet let them hang vpon the tree till they bee ripe, and they loſe their bitterneſſe, and alſo their ſharpeneſſe, by reaſon of their better concoction by heat. The like difference wee finde betweene our *oleum omphacinum*, and the ripe oyle. So likewiſe *opium*, which is held to be very cold, yet it is extreame bitter, ſo as the cold parts in it are not able to maſter the bitterneſſe, but this is ſtill predominant: wherefore heat can be no cauſe of bitterneſſe, vnleſſe it bee in exceſſe or defect, as *Scaliger* confeſſeth. Wormewood is very bitter, being hot and dry in the ſecond or third degree: if heat were the cauſe of it, then all other ſimples which are hot and dry in the ſame degree, ſhould be alſo bitter. As I haue ſaid of taſts, ſo I may ſay of all the other affections of naturall things, that they proceed not from the Elements, but from the ſeeds and formes of euery thing. So for fat and vnctuous ſubſtances, as Sulphur, Bitumen, Oyle, Greaſe, &c. vnto what Element ſhall we aſcribe them? Not vnto fire, becauſe this is extreme hot and dry, that is temperate in heat, and very moyſt. Moreouer, fire would rather conſume it, then generate it: and Phyſitians iudge the generation of fat in our bodies to proceed rather from cold, then from heat. Ayre, if it haue any ingenerate quality, as ſome doe make doubt out of *Ariſtotle*, it is cold and moyſt, as I haue ſhewed before, *cap.* 2. & 5. and therefore as it cannot agree with fire, nor be a fewell to it, ſo it cannot be any materiall cauſe of fat, or oylie ſubſtance: being more agreable to water, from whence it is thought to be made by rarefaction, and into which it is thought to be reduced by condenſation. Wherefore being of a watry nature, it cannot agree with oyle or fatneſſe, nor bee the matter of it. The like wee may iudge of water, which will not vnite with oyle, which doth terminate both

1 Meteorol. 4. Item de mundo vbi dicit aërem comparatum eſſe ad aliam & alium naturam induendam.

water

water and ayre, and therefore must be opposite to them both. As for earth, being cold and dry, and solid, it cannot be the matter of this which is temperate, and moyst, and liquid; Neither can all the Elements together make this substance, seeing there is no vnctuousnesse in any of them, and they can giue no more then they haue. So as I cannot see how this oylie substance, which is very common in all naturall things, and wherein the chiefe faculties of euery thing doth reside, as their *humidum radicale*, should be from the Elements.

So likewise for the substance wherewith euery thing is nourished and increased, and into which euery thing is resolued, it appeares not how it should bee from the Elements. *Hippocrates*, of whom *Macrobius* saith, *nec fallere nec falli potuit*, hath two notable axioms for the clearing of this poynt. The one is *Vnumquodque in id dissoluitur vnde compactum est*. Euery thing is dissolued into that whereof it was made. The other, *Iisdem nutrimur ex quibus constamus*, wee are nourished by such things as we consist of. *Aristotle* also hath the same. If this axiome be true, as I hold it to be, and I know none that contradict it, then we must consist of such things as we are nourished withall. But we are not nourished by the Elements, and therefore wee consist not of them. Fire nourisheth nothing, water nourisheth not, as Physitians confesse: Ayre is too thin a substance, and Earth too thicke. And as they doe not nourish them when they are single, so being compounded, they can doe as little. *Aristotle* saith that some Plants are nourished with water alone, some with earth alone, and some with both together. But if earth and water be mixed for our nourishment, they making but mud, would make vs haue muddy braines. We will grant the Elements to be *matrices rerum naturalium*, the wombes and nurses of

In som. Scipionis cap. 6.

De nat. haminis

De gen. cap. 8: Item lib de sensu & sensibile.

De gen. animal. cap. vltimo.

naturall things, but we will not grant them to be materiall causes. Neither can we attribute more dignity vnto them, then we doe our Mothers, who depart not from their substance whereof they consist, as flesh, bones, sinewes, veynes, arteries, &c. to the nourishment of their Infants, but onely prepare bloud for them, from the nutriments which they receiue. And all the Elements in the world cannot make this bloud, neither as the matter, nor as the efficient. But as the Mother is furnished with bloud to nourish the Infant, and with conuenient heat to foster it withall, so are the Elements stored with all manner of matter fit for all generations: so as the seeds or formes of naturall things, will neuer want matter to nourish them, nor will euer want formes. So that it is manifest that if naturall bodies be not nourished by the Elements, they are not compounded of them: but being nourished by other substances then the Elements, they must be compounded of the like; *Simile simili nutritur: composita compositis constant & nutriuntur.*

Thus much for the Genesis or generation and natation of naturall things, that thereby we cannot gather that they are either made or nourished by the Elements. Now let vs examine whether by the Analysis or dissolution of them, we may finde the foure Elements, according to the former axiome, that euery thing is dissolued into that whereof it was made, and is made of that whereinto it is dissolued, as *Aristotle*, *Hippocrates*, and *Galen* doe affirme. So that if the Elements enter into the composition of naturall things, especially as the principall materials whereof they consist, they must needs appeare in the dissolution of them. This dissolution is either naturall or artificiall. In the naturall dissolution of all things, *Hippocrates* obserues three distinct substances, *calidum, humidum sine fluidum, & siccum*

sine

siue solidum, according to the three Elements or principles whereof he saith they are framed. His instance is principally man, but he affirmes it to hold in other animate inanimate bodies. These Elements he termeth *continentia contenta & impetum facientia*, as *Galen* expounds it. Those which he cals *continentia*, are bones, nerues, veynes, arteryes, and from thence, muscles, &c. *Contenta* are *humida*, or *humores*, bloud, flegme, choller, melancholy, which after death, are cold, and congeale, being heated as *Galen* saith, from the heart, in liuing bodies: *Impetum facientia*, are spirits animall, vitall and naturall. *Isagoge cap. 8. 1 de Elementis cap. 15.*

These three Elements, *Galen* acknowledgeth to bee the neereſt, but the other which are more remote, to be most vniuersall. But *Hippocrates* saith that heat and cold, &c. are very powerlesse Elements, and that sharp, bitter, sweet, &c. are more powerfull, τῷ μεγάλῳ δυνάμιν ἔχοντα. So that these are the three Elements whereof all things doe consist, and into which they are naturally resolued. and these doe seeme to resemble the foure Elements, but are not the same. For heat may resemble fire, although this heat be procured by motion in euery thing whilest it liueth, and not extrinsecally. Moysture may resemble water and ayre. Dryness may resemble earth; cold appeares in them all after that the heat or spirit is departed. *De veteri medicina.*

In the artificiall Analysis of naturall bodies, the Alchymists tels vs that they finde three Elements, and no more, whereof euery thing doth consist, and whereinto it is resolued: namely, *Vaporosum*, *inflammabile*, *fixum*: which they call Mercury, Sulphur, and Salt, and they seeme to agree with *Hippocrates*. For their Mercury may well resemble *Hippocrates* his spirits, or *impetum facientia*: Sulphur his humors or *fluidum* or *contenta*; and Salt,

Salt, his *ſiccum* or *denſum*, or *continentia*. Theſe they ſay are found in euery thing, animal, vegetable, or minerall, and no other. And as for the foure common Elements, ſeeing they are diſtinct in place and ſcituation, and therefore cannot concurre and meet to the generation of euery animal, Plant and Minerall, &c. but by violence, the earth being ſometimes carried vpwards, and the fire downewards, contrary to their naturall motions: and this, not once for all, but daily and houreley: it is not likely that theſe ſubſtances can bee bred of the Elements, or be maintained in a perpetuall ſucceſſion by a violent cauſe. And therefore it is no maruell if theſe Elements be not found in the diſſolution of naturall bodyes. Thus much in generall concerning all generations, that hereby we may the better iudge of the particular generations of minerals, which differ not from the reſt, but onely in this, that their ſeeds are not in euery indiuiduall, as the others are, but are contained *in matricibus*, in their wombes, and there they are furniſhed with matter to produce their Species: not out of the Elements, no otherwiſe then *ex matricibus*, as the childe in the mothers wombe, but haue their matter and nouriſhment from the ſeeds of things, which are agreeable to their ſpecies: which ſeeds wanting meanes to produce their owne ſpecies, doe ſerue others, and yeeld matter and ſubſtance vnto them.

Now let vs come more particularly to the generation of minerals, wherein we will firſt examine *Ariſtotles* opinion, as moſt generally receiued, then I will preſume to ſet downe mine owne.

CAP.

Cap. 12.

The generation of minerals examined, the Authors opinion herein.

Aristotle makes the humidity of water, and the dryneſſe of earth, to be the matter of all minerals: the dryneſſe of earth to participate with fire, and the humidity of water with ayre, as *Zabarella* interprets it; ſo that to make a perfect mixt body, the foure Elements doe concurre: and to make the mixture more perfect, theſe muſt be reſolued into vapour or exhalation by the heat of fire, or influence from the Sunne and other Planets, as the efficient cauſe of their generation: but the cauſe of their congelation to be cold in ſuch bodies as heat will reſolue. This vapour conſiſting partly of moyſture, and partly of dryneſſe, if all the moyſture bee ſpent, turnes to earth or ſalt, or concrete iuyces, which diſſolue in moyſture: if ſome moyſture remaine before congelation, then it turnes to ſtone: if this dry exhalation be vnctuous, and fat, and combuſtible, then Bitumen and Sulphur, and Orpiment, are bred of it: if it be dry and incombuſtible, then concrete iuyces, &c. But if moyſture doe abound in this vapour, then metals are generated which are fuſible and malleable. And for the perfecting of theſe generations, this exhalation is not ſufficient, but to giue them their due conſiſtence, there muſt be the helpe of cold from Rockes in the earth to congeale this exhalation. So that here muſt be two efficients, heat and cold. And for the better effecting of this, theſe exhalations doe inſinuate themſelues into ſtones, in the forme of dew or froſt, that is, in little graines; but differing from dew and froſt in this, that theſe are generated after that the vapour is conuerted to

Eraſtus, Careri-us, Cæſalpinus, Martinus, Moriſinus, Foxius, Magyrus, Libavius.

3 Meteor. c. vlt. Cæſalp. l. 3. c. 1.

water; whereas Minerals are generated before this conuerſion into water. But there is doubt to bee made of froſt, becauſe that is bred before the conuerſion of the exhalation into water, as may appeare, *Meteor.* 1. According to this aſſertion there muſt be two places for the generation of minerals: the one a *matrix*, where they receiue their eſſence by heat in forme of an exhalation, and from thence they are ſent to a ſecond place to receiue their congelation by the coldneſſe of Rockes: and from this *matrix* come our minerall waters, and not from the place of congelation.

Libau. de nat. metall. c. 14. Carerius 178

Septal. in Hipp. de aere, aqu. &c.

This is the generation of minerals, according to *Ariſtotle*; but it is not ſo cleare, but that it leaues many ſcruples, both concerning the matter, and the efficients. For the matter, it ſeemes not probable, that water and earth ſhould make any thing but mudde and dirt; for you can expect no more from any thing then is in it, the one is cold and dry, the other cold and moyſt; and therefore as fit to be the matter of any other thing, as of particular minerals. And water, whereof principally metals are made to conſiſt, is very vnfit to make a malleable and extentible ſubſtance, eſpecially being congealed by cold, as wee may ſee in yce. But ſome doe adde a minerall quality to theſe materials, and that ſimple water is not the chiefe matter of metals, but ſuch as hath imbibed ſome minerall quality, and ſo is altered from the nature of pure water. This aſſertion doth preſuppoſe minerals in the earth before they were bred: otherwiſe what ſhould breed them at the firſt, when there was no minerall quality to be imparted to water? Againe, this minerall quality either giues the water or the vapour of it the eſſence of the minerall, and then it is not the effect of water, but of the minerall quality, or the potentiall faculty to breed it. If the eſſence, then this

metallin

metallin water, or vapour, must haue the forme of the metall, and so be fusible and malleable. If it haue onely the power and potentiall faculty, then the generation is not perfected, but must expect further concoction: This concoction is said to be partly by heat, and partly by cold; if by heat, it must be in the passages of the exhalation as it is carried in the bowels of the earth: for, afterwards, when the exhalation is setled in the stones, the heat is gone. Now if the concoction bee perfected before the exhalation be insinuated into the Stones, as it must be, if it be like dew, then is it perfect metall, and neither is able to penetrate the Stones, nor hath any need of the cold of them to perfect the generation. If by cold, it is strange that cold should be made the principall agent in the generation of metals, which generates nothing; neither can heate be the efficient of these generations. Simple qualities can haue but simple effects, as heate can but make hot, cold can but coole, &c. But they say cold doth congeale metals, because heate doth dissolue them; I answer, that the rule is true, if it bee rightly applied: as wee see yce which is congealed by cold, is readily dissolued by heate. But the fusion of metals cannot properly bee called a dissolution by heate, because it is neither reduced to water or vapour, as it was before the congelation by cold, nor is it permanent in that kinde of dissolution, although after fusion it should be kept in a greater heat then the cold could be which congealed it. For the cold in the bowels of the earth cannot be so great, as it is vpon the superficies of the earth, seeing it was neuer obserued that there was any yce bred there. Also this dissolution which is by fusion, tends not to the destruction of the metall (but doth rather make it more perfect) as it should doe according to the former rule rightly applied. And therefore

Valesius sacra Philosoph. c. 49.

this dissolution by fusion, doth not argue a congelation by cold: which being in the passiue elements, doth rather attend the matter, then the efficient of generations: for it is apt to dull and hebetat all faculties and motions in nature, and so to hinder generations, rather then to further any. It is heate and moysture that further generations, as *Ouid* saith, *Quippe vbi temperiem sumpsere humorque calorque, Concipiunt.*

And thus much for *Aristotles* generation of minerals, where his vapours or exhalations doe rather serue for the collection or congregation of matter in the Mynes, then for the generation of them; as *Libauius* doth rightly iudge. *Agricola* makes the matter of minerals to be *Succus Lapidescens Metallificus, &c.* and with more reason, because they are found liquid in the earth: *Gilgill* would haue it Ashes; *Democritus* Lyme: but these two being artificiall matters, are no where found in the earth. The Alchymists make Sulphur and Mercurie the matter of metals: *Libauius*, Sulphur and Vitriol. But I will not stand vpon discoursing of these materials, because it makes little to my purpose. It is enough for my purpose to shew the manner of these generations, which I take to be this.

Singularium lib. 1. part. 1.

De nat. metal. cap. 10.

There is a Seminarie Spirit of all minerals in the bowels of the earth, which meeting with conuenient matter, and adiuuant causes, is not idle, but doth proceed to produce minerals, according to the nature of it, and the matter which it meetes withall: which matter it workes vpon like a ferment, and by his motion procures an actuall heate, as an instrument to further his worke; which actuall heate is increased by the fermentation of the matter. The like wee see in making of Malt, where the graynes of Barley being moystened with water, the generatiue Spirit in them, is dilated, and put in action;

and

and the ſuperfluity of water being remoued, which might choake it, and the Barly laid vp in heapes ; the Seeds gather heat, which is increaſed by the contiguity of many graines lying one vpon another. In this worke natures intent is to produce moe indiuiduals, according to the nature of the Seede, and therefore it ſhoots forth in ſpyres : but the Artiſt abuſes the intention of nature, and conuerts it to his end, that is, to increaſe the ſpirits of his Malt. The like we find in minerall ſubſtances, where this ſpirit or ferment is reſident, as in Allum and Copperas mynes, which being broken, expoſed, and moyſtened, will gather an actuall heat, and produce much more of thoſe minerals, then elſe the myne would yeeld ; as *Agricola* and *Thurneiſer* doe affirme, and is proued by common experience. The like is generally obſerued in Mynes, as *Agricola*, *Eraſtus*, *Libauius*, *&c.* doe auouch out of the daily experience of minerall men, who affirme, that in many places, they finde their Mynes ſo hot, as they can hardly touch them : although it is likely that where they worke for perfect Minerals, the heat which was in fermentation, whilſt they were yet breeding, is now much abated: the Minerals being now growne to their perfection. And for this heate wee neede not call for the helpe of the Sunne, which a little cloud will take away from vs, much more the body of the earth, and rocks ; nor for ſubterraneall fire : this inbred heat is ſufficient, as may appeare alſo by the Mynes of Tinglaſſe, which being digged, and laid in the moyſt ayre, will become very hot. So Antimony and Sublimat being mixed together, will grow ſo hot as they are not to be touched: If this be ſo in little quantities, it is likely to bee much more in great quantities and huge rocks. Heate of it ſelfe differs not in kinde, but only in degree, and therefore is *Cæſerius p.* 212.

inclined no more to one Species, then to another, but as it doth attend and ſerue a more worthy and ſuperiour power, ſuch as this generatiue ſpirit is. And this ſpirit doth conuert any apt matter it meets withall to his owne ſpecies by the helpe of heate ; and the earth is full of ſuch matter which attends vpon the ſpecies of things: and oftentimes for want of fit opportunity and adiuvant cauſes, lies idle, without producing any ſpecies: but is apt to be tranſmuted by any mechanicall and generatiue ſpirit into them. And this matter is not the Elements themſelues, but ſubterraneall ſeedes placed in the Elements, which not being able to liue to themſelues, do liue to others. *Sic Roma creſcit Albæ ruinis*; the death of one is the life of another. From this confluence of ſeeds ariſe all the varieties and differences, and alterations which are obſerued in the generation or nutrition of naturall things: as in their colours, taſts, numbers, proportions, diſtempers, &c. Alſo from hence proceed the Tranſplantations which we finde in animals, vegetables, and minerals. In animals theſe Tranſplantations are not very frequent ; yet all our monſters may bee referred hereunto, as alſo the iſſue which comes from Dogges and Woolues, Horſes and Aſſes, Partriges and Hens, &c. Some doe thinke that the deſtruction of ſexes is a Tranſplantation, and that all ſeeds in themſelues are hermophroditicall, and neither maſculine nor feminine, but as they meet with ſtrong or weake impreſſions from ſupervenient cauſes; From hence come our *Androgyni*, or maſculine women, ſuch as *Horace* ſpeaks of, *Sabellis doctæ ligonibus verſare glebas.* Among thoſe animals which wee call *Inſecta*, theſe tranſplantations are more frequent, becauſe their ſeeds are more equiuocall, and eaſily tranſmuted from one ſpecies to another : as wee may ſee in

Muffetus in dialogo apologetico.

Wormes

Wormes and Flies, and most euidently in Silkworms called *Cavallieri.*

In vegetables these transplantations are very frequent when one species is grafted vpon another, as *Virgil* saith,

Et steriles platani malos gessêre valentes Georg. 2.
Castaneæ fagos: ornusq; incanuit albo
Flore pyri, glandemq; sues fregêre sub ulmis.

Thus by commixtion of seuerall species, the first seeds doe oftentimes bring forth other fruits then their owne.

Mirantur q; novas frondes & non sua poma.

But all, as *Hippocrates* saith, by Diuine necessity, both that which they would, and that which they would not. So likewise Wheat is changed into *Lolium*, Basil into Thyme, Musterwort into Angelica, &c. *De Diæta* 1.

In Minerals we find the like transplantations: as Salt into Niter, Copperasse into Allum, Lead into Tinne, Iron into Copper, Copper into Iron, &c. And this is the transplantation whereupon the Alchymists ground their Philosophers stone.

This Seminary spirit is acknowledged by *Aristotle: Continent* (*inquit*) *semen in se cujusq; fœcunditatis suæ causam*: and by most of his Interpreters: and *Morisinus* cals it *Elphesteria*, not knowing how to attribute these generations to the Elements. And this is the cause why some places yeeld some one vegetable or minerall species aboue another. *Quippe solo natura subest. Non omnis fert omnia tellus.* This seminary spirit of minerals hath his proper wombes where it resides, and *De gen. animal. lib. 2. Foxius, Martinus, Morisinus, Magyrus, Libavius, Velcurio, Valesius, Carerius, Erastus, &c.*

is

is like a Prince or Emperor, whose prescripts both the Elements and matter must obey: and it is neuer idle, but alwayes in action, producing and mayntaining naturall substances, vntill they haue fulfilled their destiny, *donec fatum expleverint*, as *Hippocrates* saith. So as there is a necessity in this, depending vpon the first benediction (*crescite & multiplicamini*:) and this necessity or *fatum* is inherent in the seeds, and not aduentitious from the Planets, or any other naturall cause. And this is the cause of the vniformity in euery species, that they haue all their proper figures, dimensions, numbers of parts, colours, tasts, &c. most conuenient and agreeable to each nature; as *Moses* saith, that God saw that euery thing was very good: and *Galen* saith, *Deus in omnibus optimum eligit*. And this I take to be the meaning of his *Lex Adrastiæ*, which hee alleageth against *Asclepiades*. For if hee should meane it as commonly it is vnderstood, of punishment which alwayes follows sinne, *nemo crimen in pectore gestat, qui non idem Nemesin in tergo*: in this sense he could not apply it to the confuting of *Asclepiades*. There are also other lawes in nature which cannot be altered, both Mathematicall, in Arithmetick and Geometry, and Logicall, in the consecuting of arguments, &c. But these serue not for *Galens* purpose in this place. He must meane it of a naturall necessity or *fatum*, or predestination, frames euery member and part of the body to the best vse for the creature. And therefore where *Asclepiades* propounds an inconuenient frame of parts, he confutes him by this inbred law of nature, which hee saith, no man can alter or auoid, nor any subtilty elude, as *Aristotle* also saith. Thus much for the generation of Minerals and other naturall substances.

De Diæta lib. 1.

6 De usu partium cap 12. & 13

Erasmus in Adagiis.

De mundo c. ult.

CAP.

Cap. 13.

Of the causes of actuall heat, and medicinable virtue in Minerall waters, diuers opinions of others, reiected.

NOw I come to shew how our Minerall waters receiue both their actuall heat, and their virtues. I ioyne them together, because they depend vpon one and the same cause, vnles they bee iuyces which will readily dissolue in water, without the helpe of heat : other Minerals will not, or very hardly.

This actuall heat of waters hath troubled all those that haue written of them, and many opinions haue beene held of the causes of them.

Some attribute it to wind, or ayre, or exhalations included in the bowels of the earth, which either by their owne nature, or by their violent motion, and agitation, and attrition vpon rocks and narrow passages, doe gather heat, and impart it to our waters. Of their owne nature these exhalations cannot bee so hot, as to make our water hot, especially seeing in their passage among cold rocks, it would bee much allaied, hauing no supply of heat to maintaine it. Moreouer, where water hath passage to get forth to the superficies of the earth, there these exhalatious and winds will easily passe, and so their heat gone withall, and so our waters left to their naturall coldnesse : whereas wee see they doe continue in the same degree and tenor, many generations together. If by their agitation and violent motion they get this heat, because no violent thing is perpetuall or constant, this cannot be the cause of the perpetuall and constant heat of water. Besides, this would rather cause earthquakes and stormes, and noy-

ſes in the earth, then heat our ſprings. Moreouer, wee daily obſerue, that exhalations and water are neuer heated by motion, or agitation; as in the Cataracts of the Rhein by Splug; the agitation and fall of water vpon rocks is moſt violent, and make a hideous noyſe; yet it heats not the water, though it bee very deepe in the earth. Neither can any attrition heat either ayre, or water, or any ſoft and liquid thing, but rather make it more cold.

Valeſius contro. lib. 4. cap. 3. Sulmand. l. 1. c. 4.

Others attribute this actuall heat of Bathes vnto the Sunne, whoſe beames peircing thorow the pores of the earth, doe heat our waters. If this heat which heats our Bathes be cauſed by the beames of the Sunne, then either they bring it intirely from the Sunne, as a quality proceeding from thence, or they make it by their own motion. If it come from the nature of the Sunne, the Sunne muſt bee extreame hot that can heat theſe inferior parts at ſuch a diſtance: eſpecially the beames which muſt carry it, paſſing thorow the middle region of the ayre, which is alwayes extreame cold, and cannot but coole thoſe beames before they come to vs. And if they were able to paſſe that region without loſing their heat, yet they cannot but warme that region, being nearer to their fountaine of heat, as well or better then they can warme our waters, in deſpite of any Antiperiſtaſis. But it is doubtfull whether the Sunne bee hot of his owne nature or no. The Peripateticks hold it to be hot and dry moderately; yet it muſt be extreme hot, if in this manner it doe heat our Bathes. And if the Sun be capable of heat, they muſt alſo make it capable of cold (elementary qualities) and then they make celeſtiall bodies obnoxious to generation and corruption; which they are not willing to grant. Although in this reſpect they need not feare the decay of the Sun,

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no more then of the globe of the earth: which though it ſuffer in his parts many alterations, yet the whole remaines firme and perpetuall, as M. Doctor *Hakwell* proues in his learned worke vpon that argument; and will ſo doe vntill it bee diſſolued by that omnipotent power which framed it. If they make this heat to come from the motion of the Sunne, wee muſt conſider how the Sunne by motion may get ſuch a heat. The Sunne is either moued by his owne motion, or as hee is carried in his Spheare wherein he is fixed. If by his own motion, it muſt bee either by volutation vpon his *axis*, which is called κύλισις, or by circumgyration, which is called δίνησις, round about the globe of the earth: and this is the common opinion; which if it be ſo, he muſt be carried more ſwiftly then a bullet out of a peece of Ordnance. I read in the Turkiſh Hiſtory at the ſiege of *Scodra*, of a bullet of twelue hundred weight ſhot out of a Cannon called the Prince, and it ſeemes a great matter. But to haue ſuch a bullet as the globe of the Sunne, which is held to be 166 times bigger then the globe of the earth, to bee carried in a ſwifter courſe, and that perpetually, is a monſtrous, furious, and mad agitation, *inſanus motus*, as one termeth it. The like may be ſaid of the motion of the Spheares: but I will leaue the confutation of this to others. But admit it to be ſo, and that this violent agitation is not repugnant to the perpetuity of the heauens; and that it is able to breed an extreme heat in the Sun and celeſtiall Spheres, notwithſtanding their tenuity, &c. which is vnapt to breed heat by motion or colliſion, for that is proper to ſolid ſubſtances: yet this heat muſt bee conueyed to vs by the ſame beames of the Sunne, and muſt bee ſubiect to the former impediments.

Gilbertus de magnete lib 6. Taurellus de primis rerum principijs. Conrad. Aſſicus de triplici cœlo.

Wherefore the beames of the Sunne by their motion

muſt make this heat, by the collection of many beames together. For if they be diſperſed, no fire will bee kindled, but only ſome moderate heat: as wee ſee in a burning glaſſe, which will heat a white paper or cloth, but not burne it. Other things it will burne, which are apt fewels; but the whitenes of the paper or cloth it ſeemes diſperſeth the beames. But no doubt the Sunne by his light and beames do warme theſe inferior parts, eſpecially where they haue free paſſage, and reflection withall, and it is to be iudged, that the heat not being eſſentially in the Sunne, is an effect of the light by whoſe beames it is imparted to vs: So as where light is excluded, heat is alſo excluded. And if wee can exclude the heat of the beames of the Sunne by the interpoſition of a mud wall, or by making a Cellar ſix foot vnder the ground; how is it likely that theſe beames can pierce ſo deepe into the earth, as to heat the water there? as *Lucretius* ſaith,

Qui queat hic ſubter tam craſſo corpore terram
Lib 6. *Percoquere humorem, & calido ſociare vapori?*
Præſertim cum vix poſſit per ſepta domorum
Inſinuare ſuum radijs ardentibus æſtum.

And if the beames of the Sunne be not able to heat a a ſtanding Poole in the midſt of Summer, how ſhould they heat a ſubterraneall water, which is alwayes in motion, eſpecially in the winter time? Againe, if this heat come from the Sunne, then in the Summer, when the Sunne is hotteſt, the waters ſhould bee ſo alſo, and in winter cold, becauſe of the abſence of the Sunne; but we finde them alwayes alike. Alſo why ſhould the Sunne heat ſome few fountaines and paſſe ouer an infinite number of others, which are left cold? And

why

why ſhould there bee hot fountaines in cold Climats, where the Sunne hath little power to heat, either by reaſon of his oblique beames, or by reaſon of his long abſence; and yet in hot Climats they ſhould be ſo rare? wherefore it is very improbable that our ſprings are heated by the Sunne.

Others haue deuiſed another cauſe of this actuall heat of Bathes, more vaine then the former, which they call Antiperiſtaſis: where by reciprocation or compreſſion, any quality is intended and exalted to a higher degree. As where heat or cold are compaſſed by their contrary quality, ſo as the vapors or *effluvium* of it is reflected back againe, the quality thereof is encreaſed. *Hippocrates* giues vs an example of it in our owne bodies, where he ſaith, *ventres hieme calidores*, our ſtomachs are hotter in Winter then in Summer, by reaſon the ambient ayre being then cold, doth ſtop the pores of the skin, and repell thoſe fuliginous vapours which nature would breathe forth, and ſo our inward heat is encreaſed: whereas in the Summer, by reaſon of too much euentilation, our naturall heat is diminiſhed: and therefore we concoct better in winter then in Summer. And although it bee not ſimple heat which concocts, and makes *chylus* in the ſtomach, blood in the liuer, ſeed in the ſpermatick veſſels, or milke in the breaſt, &c. as *Ioubertus* ſaith: yet heat attending vpon the faculties of thoſe parts, doth quicken them, as cold doth benumbe them. But if we examine this example aright, wee ſhall finde a great difference betweene this and our hot Bathes. For the heat in our bodies is continually fed and maintainde from the heart by his motion: that of Bathes hath no ſuch ſupply according to their doctrine, from any cauſe to make or continue this heat. And therefore the repelling of vapours cannot make

In Paradoxis.

water hotter then it is : and being naturally cold, and without any heat ; where heat is not, how can it bee pend in or repelled? Againe, in *Hippocrates* his example there is an *interſtitium* (our skin) betweene the fuliginous vapours and the externall ayre, which keepe them from vniting : but in our Bathes there is nothing to hinder the meeting and coniunction of theſe qualities, and then the one muſt dull the other. Moreouer, we ſee that any thing that is naturally cold, as iron or a ſtone, if it bee made hot accidentally by fire or otherwiſe, it is ſooner cold in cold ayre, then in a warme place. So that the Antiperiſtaſis doth rather diminiſh then encreaſe the heat of it. Wherefore vnleſſe water were naturally hot, or the heat maintained by ſome continuall cauſe, this Antiperiſtaſis can doe no good, but by his oppoſite quality would rather coole it. Nay heat it ſelfe cannot make any thing more hot, vnleſſe it bee greater then the heat of the thing it ſelfe. But to aſcribe the generation of heat to cold, and ſo to make it the cauſe of his contrary, is againſt the law of Nature. No quality of it ſelfe is encreaſed by his contrary. It is true, that a pot of water ſet ouer the fire, will bee ſooner hot, being couered, or otherwiſe the vapours kept in, then being open : but there muſt be fire then to heat it, and to continue the heat : otherwiſe the Antiperiſtaſis will doe nothing, vnleſſe it make it more cold, and congeale it into yce, if the ayre ambient be more cold then the water. Some may obiect, that they finde ſome fountaines warmer in Winter then in Summer, and to reak when they breake forth into the ayre ; as I haue ſeene at *Wickſworth* and *Bakewel* in Darbyſhire : and therefore this doth argue an Antiperiſtaſis. *Galen* thinkes that theſe waters do but ſeem ſo to our ſenſe: our hands being hot in Summer, and cold in Winter, as our vrins

3. *ſimpl. medic. f acult. cap. 7.*

ſeeme

seeme cold in a hot Bath. But I will grant with *Valesius* that many deepe fountaines may bee so indeed, and not in appearance only, as partaking with some warme exhalations, especially in Minerall Countreys, as Darbyshire is.

Moreouer, if our Bathes were heated by an Antiperistasis, then they should bee hotter in Winter then in Summer; but wee finde them alwayes alike. Also if a cold ambient bee able to make cold water hot, why should not a hot ambient make it more cold? especially seeing the vapours are cold, which being repelled by heat, which doth terminate cold, should encrease the coldnesse of the water. Also if we should grant this Antiperistasis, wee must deny the reaction and resistance betweene the qualities of the Elements: and so ouerthrow all temperaments which arise from thence: and also our composition of medicines were in vain. Wherefore this Antiperistasis is an idle inuention to maintaine this purpose.

Valesius contro: lib. 1. cap. 5. Magyrus lib. 3. cap. 3.

Others attribute this actuall heate to quicke Lyme, which wee see doth readily heat any water cast vpon it, and also kindle any combustible substance put into it; this is *Democritus* his opinion. To this I answer, that Lyme is an artificiall thing, not naturall, and is neuer found in the bowels of the earth. Besides, if it were found, one fusion of water extinguisheth the heat of it, and then it lyeth like a dead earth, and will yeeld no more heat. So as this cannot procure a perpetuall heat to Bathes: neither can the Lymestones without calcination, yeeld any heat to water, nor will breake and crackle vpon the affusion of water, as Lyme doth. Wherefore this opinion is altogether improbable.

Others attribute this actuall heat to a subterraneall fire kindled in the bowels of the earth. Let vs consider how

how this may be. Fire is a quality, and the higheſt degree of heat, which cannot ſubſiſt without a ſubiect: For I define it to be *intenſiſsimus calor in corpore cremabili*: and it is receiued into his ſubiect either by propagation or coition, as when one candle lights another, or by motion, as colliſion, concuſſion, dilatation, compreſſion, putrefaction, fermentation, reflection, &c. yet all motion doth not kindle fire although it heat; neither are all ſubſtances apt to be heated by motion. Ayre and water are rather colder by motion: But this rule holds in ſuch things as are apt to receiue heat by motion, as ſolid ſubſtances, combuſtible ſubſtances, &c. And the heat of animals, vegetables, and minerals, which they haue for their generation and nutrition, is from motion: although this heat is not in ſo high a degree as fire is: for then it would conſume them; but as the motion is moderate, and agreeable to each nature, ſo is the heat. This motion in naturall things proceeds from their ſeeds or formes, and may be called internall or naturall. Externall motions are violent agitations, concuſſions, &c. which commonly kindle fire in apt matter. As for the element of fire, which ſhould bee pure, not ſhining, and therefore inviſible, and ſubſiſting without a ſubiect or fewell: let them finde it who know where to ſeeke for it. For my part I know no element of fire, vnleſſe we ſhould make it to be that which is naturall to all creatures and their ſeeds, cauſing their fermenting heat, whereof I ſhall ſpeake anon. And this interpretation we may well make of *Hippocrates*, where he ſaith, that all things are made of fire and water: and that theſe two are ſufficient for all generations: fire giuing motion, and water nutrition. And it is not likely that this fire ſhould be fetched from a remote place, and downwards, againſt the nature of fire, for euery generation:

De dieta lib. 1.

tion: but that it be neare hand, and inbred in the seeds themselues, as the principall ingredient into euery naturall thing: whereas if it were remote, what should bring it continually, and vnite it with the other elements in these generations? Wherefore this is most likely to be the element of fire. Our burning fire is all of one nature, not differing in kinde, but only in degree according to the quality of the fewell. Some fewels will make a manifest flame, as all thinne and light substances, Sulphur, liquid Bitumen, Oyle, Fat, &c. Some onely a glowing coale, with little or no flame, as some sorts of Stonecoale. Yet all fire doth send forth fuliginous vapours, which would choake it if there were not vent for them into the ayre: as wee see in the making of Charcoale, although they couer their fire with lome, yet they must leaue some vent for the smok: though not so much as may make it to flame, yet enough to maintaine the fire. Of the first flaming sort there are diuers degrees, as that of straw, Brimstone, spirit of wine, Naphtha, Petroleum, &c. Some of which will scarcely take hold vpon other fewell: as one may wet a linnen cloath in spirit of wine, and being kindled, he shall hardly finde the cloath scorched. The like hath beene obserued in that exhalation which is called *ignis fatuus*, being of a very thin substance, from Bitumen or Naphtha. Some reckon Comets among these fiery exhalations: but I can hardly beleeue that they are any kindled substances. First, because their flame is not pyramidall, as it is in all kindled substances. Secondly, because if they be of a thin substance from Sulphur and Bitumen, the flame would be greater, seeing it must bee plentifull, if it continue so long in burning, as we finde them to doe. Or admit that this matter bee kindled by succession, yet it is incredible that it should continue

burning aboue a yeare together: as that Comet *Xiphias*, which lasted a whole yeare: Another, *Anno* 1572. vnder the constellation of *Cassiopæa*, lasted a yeare and a halfe, others sixe moneths, others three, &c. if the Sulphureous or Bituminous matter bee thicke, it will melt in burning, and raine downe Brimstone and Bitumen vpon vs. Thirdly, if Comets were kindled substances, what entertainement could they finde aboue the Moon, and among the spheares, where they say no corruptible or elementary substance can be indured. But many of our Comets haue beene obserued to haue beene aboue the Moone, and some among the fixed starres, as hath beene obserued by *Ticho Brache*, and *Clauius*: and vpon due obseruation they could finde some of them to admit no Paralaxis, or diuersity of aspect to any starre in different climats.

This argument may be good against a Peripatetick; but a Platonist, or a Pythagorean, who hold the heauens to be made of elementary matter, and subiect to generation and corruption, will not allow it, no more will many of our Diuines.

For glowing fires, we haue none but they must bee kindled, and then they must haue vent for their fuliginous vapours, and they must be kindled either by propagation or coition from some other fire, or by violent motion able to kindle them, which wee shall hardly finde in the bowels of the earth, where all is quiet, and no space for any such perturbation.

But they say there is an *ignis subterraneus*, which being kindled vpon Sulphur and Bitumen, disperseth it selfe among other Mynes of the like nature, and sets them on fire. Now wee are come from heauen to hell, or to purgatory at the least, which *Pythagoras* cals *materiam vatum falsiq; pericula mundi*; The dreame of

Metamorph. 15.

Poets,

Poets, and a forged feare. The largeſt deſcription of it is in *Virgil*: from whence both Diuines and Philoſophers deriue much matter: and *Baccius* doth beleeue that there is ſuch a thing in the center of the earth. But if wee obſerue *Virgil* well, wee ſhall finde that hee propounds it but as a dreame: for in the end of that booke he ſaith,

Sunt gemina ſomni porta; quarum altera fertur, *Eneid.6.*
Cornea, qua veris facilis datur exitus umbris:
Altera candenti perfecta nitens Elephanto,
Sed falſa ad Cœlum mittunt inſomnia manes:

Dreames haue two gates, the one is ſaid to be
Of Horne, through which all true conceits do flee:
The other framed all of Iuory rare,
But lets out none but ſuch as forged are.

Now ſaith he, when *Anchyſes* had led *Æneas* and *Sibylla* through hell, hee lets them forth at the Iuory gate (*Portaque emittit Eburna*:) As if he ſhould ſay; all that I haue related of hell, is but a fiction; and thus *Ludovicus Vives* interprets it in his Comment vpon this place.

I hope none will thinke that I deny a hell, but I approoue not of the aſſignement of it to the center of the earth, or that that fire ſhould ſerue, as *Baccius* would haue it, to further all generations in the earth: and as others, to bé the cauſe of Fountaines, Windes, Earthquakes, Vulcanoes, Stormes, Saltneſſe of the Sea, &c. nor of the actuall heat of our Bathes, although it be the moſt common receiued opinion.

Firſt for the place, it is not likely that the center of the earth, whither all heauy things do tend, ſhould bee

hollow, but rather more compact then any other part of the earth, as likewise *Valesius* thinks: but if there be any concauities, they are betweene the Center and the Superficies; and these concauities being receptacles of water from the Sea, cannot also receiue fire. These two will not agree together in one place, but the one will expell the other: for whereas some hold that Bitumen will burne in water, and is nourished by it, it is absolutely false, as experience shewes; and I haue touched it among the *Bitumina.*

Agricola. Baccius l.1.c.19.

Moreouer, if the heat which warmes our Bathes did proceed from hence, there must bee huge vessels aboue the fire to containe water, whereby the fire might heate it, and not be quenched by it. Also the vapours arising from hence, must bee hotter then water can endure, or be capable of: for as they ascend towards the superficies of the earth, they must needs be cooled as they passe by rocks, or else they could not be congealed into water againe: and after this congealation, the water hath lost most of his heat, as we finde in our ordinary distillations of Rosewater, &c. where wee see our water to descend into the receiuer, almost cold; so that they cannot deriue our hot Bathes from hence.

Secondly, for the fire it selfe, although water and ayre may be receiued into the bowels of the earth, yet there is great difficulty for fire. For the other two neede no nourishment to support them, as fire doth. If there be not competency of ayre to nourish the fire by venting his fuliginous vapors, howsoeuer there bee fewell enough, it is suddenly quenced, and such huge and flaming fire as this must bee, will require more ayre then can there be yeelded: a great part thereof passing away through the secret creeks of rocks, and little or none entring through the Sea. And therefore daily experi-

ence

ence ſhewes, that our minerall men are faine to ſink new Shafts (as they call them) to admit ayre to their works, otherwiſe their lights would goe out. Although one would thinke, that where many men may haue roome enough to work, there would be ſpace enough for ayre to maintaine a few lights The like we ſee in Cupping-glaſſes, where the light goes out as ſoone as they are applied. Alſo there are no fires perpetuall, as hot Bathes are, but are either extinct, or keepe not the ſame tenor. Wherefore fire cannot bee the cauſe of this conſtant heat of Bathes. It muſt bee a contituall cauſe that can make a continuall heat. Alſo where fire is, there will be ſmoak, for as it breeds exhalations, ſo it ſends them forth. But in moſt of our hot Bathes wee finde none of theſe dry exhalations. Moreouer, fire is more hardly pend in then ayre ; yet wee ſee that ayre doth breake forth : wherefore fire ſhould alſo make his way, hauing fewell enough to maintain it. So they ſay it doth in our Vulcanoes at Hecla in Iſeland, Ætna in Sicily, Veſuvio in Campania, in Enaria, Æolia, Lipara, &c. But it is yet vnproued that theſe eruptions of fire do proceed from any deep cauſe, but only are kindled vpon or neere the ſuperficies of the earth, where there is ayre enough to feed it, and meanes enough to kindle it by lightnings, or other caſuall meanes. Whereas in the bowels of the earth, there is neither ayre to nouriſh it, nor any meanes to kindle it ; ſeeing neither the beames of the Sunne, nor Wind, or other Exhalations, nor any Antiperiſtaſis, nor Lyme, nor Lightnings can do it. For the ſame reaſons that exclude the beames of the Sunne and exhalations, will likewiſe exclude lightnings.

Thirdly, for the fewell, there are only two ſubſtances in the bowels of the earth, which are apt fewels for fire, Bitumen and Sulphur.

Donatus de aquis Lucensibus lib.1.cap.18.

Sulphur is in such request with all men, as they think there can bee no hot Bath without it: nay many hold, that if water do but passe thorow a myne of Brimstone, although it be not kindled, but actually cold, yet it will contract from thence, not only a potentiall, but an actuall heat. But we do manifestly finde, that neither all hot waters are sulphurous, nor all sulphurous waters hot (as is said before in Sulphur.)

Gesner. Epist. lib.3.pag.90.

The Baths of Caldanella and Avinian, *in agro Senensi, de Grotta in Viterbio, de aquis in Pisano, Divi Iohannis in agro Lucensi, Balneum Geberſuilleri in Halsatia, &c.* are all hot, and yet giue no signe of Sulphur, either by smell, or taste, or quality, or effect. Contrariwise that all sulphurous waters are not hot, may appeare by the Bathes of Zurich in Heluetia, of Buda in Pannonia, at Cure in Rhetia, Celenses in Germany. In Campania, betweene Naples and Puteolum, are many cold sulphurous Springs. At Brandula *in agro Carpensi, &c.* All which Bathes shew much Sulphur to bee in them, and yet are cold. And no maruell, for if we infuse any simple, bee it neuer so hot potentially, yet it will not make the liquor actually hot. Wherefore this Sulphur must burne before it can giue any actuall heat to our Bathes; and then it must needs bee subiect to the former difficulties, and also must bee continually repaired by new generations of matter, which actuall fire cannot further, but rather hinder. The fire generates nothing, but consumes all things.

Lib.1. cap.ult.

The like we may iudge of Bitumen, that vnlesse it be kindled, it can yeeld no heat to our Bathes: as *Solinander* reports of a Bituminous Myne in Westfalia, *in agro Tremonensi*, where going downe into the groue, hee found much water hauing the smell, taste, and colour of Bitumen, and yet cold. *Agricola* imputes the chiefe

cause

cause of the heating of Bathes, vnto the fewell of Bitumen; *Baccius* on the other side to Sulphur. But in mine opinion, they need not contend about it. For, as I haue shewed before in the examples of Minerall waters, there are many hot Springs from other minerals, where neither Sulphur nor Bitumen haue beene obserued to bee. *Iohn de Dondis*, and *Iulius Alexandrinus* were much vnsatisfied in these opinions, and did rather acknowledge their ignorance, then that they would subscribe vnto them. I need not dispute whether this fire bee *in Alveis*, or *in Canalibus*, or *in vicinis partibus, &c.* because I think it is in neither of them.

Cap. 14.

The Authors opinion concerning the cause of actuall heat, and medicinable virtue in Minerall waters.

WHerefore finding all the former opinions to be doubtfull and weakly grounded concerning the causes of the actuall heat of Bathes; let mee presume to propound another, which I perswade my selfe to bee more true and certaine: But because it hath not beene mentioned by any Author that I know, I haue no mans steps to follow in it.

Avia Doctorum peragro loca, nullius ante
Trita solo.

I trauell where no path is to be seene
Of any learned foot that here hath beene.

Which makes me fearfull in the deliuery of it. But

if

if I doe erre in it, I hope I ſhall not be blamed; ſeeing I do it in diſquiſition of the truth.

I haue in the former Chapters ſet downe mine opinion concerning the generation of minerals, that they haue their ſeminaries in the earth repleniſhed with ſpirits, and faculties attending them; which meeting with conuenient matter and adiuuant cauſes, doe proceed to the generation of ſeuerall ſpecies, according to the nature of the efficient, and aptneſſe of the matter. In this work of generation, as there is *generatio unius*, ſo there muſt bee *corruptio alterius*. And this cannot bee done without a ſuperiour power, which by moyſture, dilating it ſelfe, worketh vpon the matter, like a ferment to bring it to his owne purpoſe. This motion betweene the agent ſpirit, and the patient matter, produceth an actuall heat (*ex motu fit calor*) which ſerues as an inſtrument to further this work. And this motion being naturall and not violent produceth a naturall heat which furthers generations; not a deſtructiue heat. For as cold duls, and benumbes all faculties, ſo heat doth quicken them. This I ſhewed in the example of Malt. It is likewiſe true in euery particular graine of Corne ſowne in the ground, although by reaſon they lie ſingle, their actuall heat is not diſcernable by touch; yet wee finde that externall heat and moyſture doe further their ſpiring, as adiuuant cauſes; where the chiefe agent is the generatiue ſpirit in the ſeed. So I take it to be in minerals, with thoſe diſtinctions before mentioned. And in this all generations agree, that an actuall heat, together with moyſture, is requiſite: otherwiſe there can neither be the corruption of the one, nor the generation of the other. This actuall heat is leſſe ſenſible in ſmall ſeeds and tender bodies, then it is in the great and plentifull generations, and in hard and compact matter:

for

for hard bodies are not so easily reduced to a new forme, as tender bodies are; but require both more spirit and longer time to bee wrought vpon. And therefore whereas vegetable generations are brought to perfection in a few months, these minerall generations do require many yeares, as hath been obserued by Minerall men. Moreouer, these generations are not terminated with one production, but as the seed gathereth strength by enlarging it selfe, so it continually proceeds to subdue more matter vnder his gouernment: so as, where once any generation is begun, it continues many ages, and seldome giues ouer. As we see in the Iron mynes of Illua, the Tinne mynes in Cornwall, the Lead mynes at Mendip, and the Peak, &c. which doe not only stretch further in extent of ground, then hath beene obserued heretofore; but also are renewed in the same groues which haue beene formerly wrought, as our Tinners in Cornwall do acknowledge; and the examples of Illua and Saga before mentioned, doe confirme. This is a sufficient meanes for the perpetuity of our hot Springs; that if the actuall heat proceed from hence, there need be no doubt of the continuance of them, nor of their equall tenor of degree of heat.

Now for the nature of this heat, it is not a destructiue heat, as that of fire is, but a generatiue heat ioyned with moysture. It needs no ayre for euentilation, as the other doth. It is in degree hot enough for the hottest Bathes that are, if it bee not too remote from the place where the water issueth forth. It is a means to impart the qualities of minerals to our waters, as well as heat, by reason the minerals are then *in solutis principijs*, in their liquid formes, and not consolidated into hard bodies. For when they are consolidated, there are fewof them that will yeeld any quality to water, vnlesse they

be the concrete iuyces, or any actuall heat, becauſe that is procured by the contiguity of bodies, when one part lyeth vpon another, and not when they are growne *in corpus continuum*; as we ſee in Malt, where by turning and changing the contiguity, the heat is increaſed, but by ſuffering it to unite, is quenched: But before conſolidation, any of them may yeeld either ſpirit, or iuyce, or tincture to the waters, which by reaſon of their tenuity (as is ſaid before) are apt to imbibe them. Now if actuall fire kindled in the earth, ſhould meet with theſe minerals whilſt they are in generation, it would diſſipate the ſpirits, and deſtroy the minerals. If it meet with them after conſolidation, it will neuer be able to attenuate them ſo, as to make them yeeld their qualities to water. For wee neuer finde any metals or minerals melted in the earth, which muſt be, if the heat of actuall fire were ſuch as is imagined: neither doe wee euer finde any flores of metall ſublimed in the earth. This naturall heat is daily found by our Minerall men in the Mines, ſo as oftentimes they are not able to touch them, as *Agricola* teſtifieth; although by opening their groues and admiſſion of ayre, it ſhould be wel qualified. Whereas on the other ſide, it was neuer obſerued, that any actuall kindled fire was euer ſeene by workmen in the earth, which were likely to be, if theſe fires were ſo frequent.

Thurneiſer Alchimiæ magnæ lib. 4. c. 8.

Wherefore ſeeing we ſee that Mineral waters do participate with all ſorts of Minerals, as well metals as other, as hath beene ſhewed in the particular examples of all of them: ſeeing alſo that few of them, vnleſſe Minerall iuyces, are able to impart their quality to water, as they are conſolidated, but only as they are *in ſolutis principijs*, and whilſt they are in generation, as is agreed vpon by all Authors: ſeeing alſo this naturall heat of fermentation

mentation must necessarily be present for the perfecting of their generation, and is sufficient, in regard of the degree of heat to make our Bathes as hot as they are: seeing also that the other aduentitious fire would rather destroy these Minerals, then further them : seeing also we cannot imagine it either likely, or possible, without manifold difficulties, and absurdities : I doe conclude that both the actuall heat of Bathes, and the Minerall qualities which they haue, are deriued vnto them by meanes of this fermenting heat. Which is still *in fieri*, not *in facto esse*, as the Schoolmen term it : and therefore makes the heat continuall.

Examples might be brought from all kinde of generations, and from some artificiall workes, of this fermenting heat proceeding from the seeds of naturall things. These seeds containing the species and kindes of naturall bodies, are not from the Elements, but are placed in the Elements, where they propagate their species, and indiuiduals, according to their nature; and haue their due times and seasons of appearing vpon the Stage of the world. Animals haue their set times when their spermatick spirits are in turgescence, some once, some twice a yeare, and some oftner : especially in the Spring ; *vere magis, quia vere calor redit ossibus* ; as *Virgil* speakes of Mares : only man in regard of his excellency aboue other creatures, is not so confinde. *Martin. de prima generatione.*

Vegetables haue likewise their seasons of setting and planting, as they may haue the earth and the season most conuenient : yet at any time, if their seeds get moysture and heat to dilate them, they will ferment and attempt the production of moe indiuiduals : but oftentimes the Artist doth abuse this intention of nature, and conuerts it to his ends : and oftentimes nature

being set in action to proceed *à potentia in actum*, doth want conuenient meanes to maintaine her worke: as when we see a Ryck of Hay or Corne which hath receiued moysture, burnt to ashes. So in the making of Malt, or Woad, or Bread, or Beere, or Wine, &c. wee make vse of this generatiue spirit for our ends: that we may stirre vp, and quicken it. Otherwise our Bread would not be so sauory, our Beere would be but Wort, our Wine would bee but Must, or Plumpottage, and want those spirits which we desire; and which lie dead and benumbed in the seeds, vntill they come to fermentation. And in all these there is an actuall heat, although it appeare not in liquid things, so well as in dry: because it is there quenced by the abundance of moysture; yet wee may obserue actiue spirits in it, by the bubling and hissing, and working of it. This is euident in artificiall Wines, which may bee made of Figs, Dates, dried Reysins, Currants, Slowes, Strawberries, Brambleberries, and such like, when they are infused in water. They will ferment of their owne accord, by vertue of the seeds which are in them, and make as good and as naturall Wine as the iuyce of the greene fruit, as I haue often proued. The Turks haue a drink which they call Couset or Posset, which is made of Barly after such a manner, as *Bellonius* reports in his obseruations. It seemes also that the Scythians drink was made in this manner, which *Virgil* speaks of.

Lib. 2. cap. 98.

Georg. 3.

Hic noctem ludo ducunt; & pocula læti
Fermento atque acidis imitantur vitea sorbis.

And I perswade my selfe that we haue not yet attained to the perfect artifice of our Beere and Ale, which stands vpon the same grounds, and may bee wrought

in

in such a manner, if any would take the paines to try some conclusions vpon it. It might saue much fewell, and vessell, and labour, and perhaps with aduantage in the product. For I see but two points to be obserued in the working of it: the one is to extract the substance of the Malt into water: the other to giue it his due fermentation. And both of these may be done without boyling. But the artifice will differ somwhat from Wine, and will require many conclusions to be tryed vpon it, before it be brought to perfection. I do mention these artifices only to shew the power of this seminary and fermenting spiririt, and how it may be drawne to other vses for our benefit. As this is found in vegetables, so likewise in Minerals; which as they haue this generatiue spirit for the propagation of their species, as hath beene shewed before, so they haue this meanes of fermentation, to bring them from a potentiall quality, to an actuall existence. And as their matter is more plentifull, and in consistence more hard and compact; so these spirits must be more vigorous and powerfull to subdue it: and consequently the heat of their fermentation must be in a higher degree, then it is in other generations.

Now hauing shewed the erroneous opinions of others concerning this actuall heat of Bathes, and explaind our owne conceit of the true cause of it; let vs collect our arguments together, the principall whereof are here and there dispersed in this Treatise, *quem nos stramineum pro tempore fecimus*, hoping that hereafter some worthy pen may handle this argument more accurately, and giue it a better flourish, *& dare perpetuo cœlestia fila metallo.* We must not imagine that the gouernment and ordering of the world and nature in a constant course, is performed by miracle, but that naturall

turall effects haue naturall causes, and must be both vnder the same *genus*. Wherefore following the ordinary distribution, seeing it comprehends all, and not questioning the celestiall bodies, whether they be Elementary or no, that is, subiect to alterations, as intention and remission, generation and corruption, &c. Wee say that this heat must proceed either from the superior and celestiall bodies, as the Spheares and Starres, or from the inferior or sublunary.

From the superior Spheares or Globes it cannot proceed, seeing (as is shewed before) they are neither indowed with such a degree of natiue heat, nor can acquire it accidentally by their motion, being thinne and liquid bodies; neither, if they had it, can they conuey it vnto the earth, but by their beames, which are not able to reteine it as they passe thorow the cold region of the ayre, nor able to warme that, although it bee neerer to their fountaine of heat. Wherefore if these beames can any way do it, it must be by their motion and reflection vpon the earth: and this is no constant heat, but varieth according as the beames are perpendicular or oblique, and according as the ayre is cleere or cloudy, &c. And as they are not able to giue this constant heat, so the earth in her bowels is not capable to receiue it, being hindered by the density of the earth and rocks, and the heat of reflection taken away before it come three foot deep.

From the inferior parts of the world if it proceed, it must bee either from the Elements, or from mixt bodies. From the Elements it cannot come, but from fire; for all the other Elements are cold, as I haue shewed, especially the earth where this heat is ingendred.

And as for the Element of fire, seeing wee know not where to finde it, neither, if it be any where, doth it performe

forme the office of an Element in production and nutrition of creatures; as *Aristotle* saith, *Ignis nil generat*, and therefore *nil nutrit*; *nam nutritio fit ex ijsdem ex quibus constat*: therefore as it begets nothing, so it nourisheth nothing; and so cannot be an Element, nor as an Element maintain this heat of Bathes. But contrariwise if it haue no power of begetting or nourishing any thing, it must haue a power of destroying or hindering nature in her proceedings; for nature will admit of no *vacuum* or idle thing. Also seeing nature vseth no violent meanes to maintain her selfe, this Elementary fire cannot be pend in the center of the earth, being of a thin subtill nature, and naturally aspiring vpwards: and if it haue any place assigned vnto it, it must bee aboue the other Elements, and then it cannot be drawne downwards against his nature, and that continually, without breach of the order and course of nature. And whereas they place the Element of fire vnder the concaue of the Moone, being in it selfe lucid and resplendent, it is strange that it is not seen by vs, neither makes our nights light. For although by reason of his transparency it doth not terminate our sight, yet it should remoue the obscurity of our nights much better then the *Via lactea*. Moreouer, if it were there, wee must see the Starres through a double *Diaphanum*, one of ayre, and another of fire, and so would make a double refraction: which is elegantly confuted by *Iohn Pena* and *Conradus Aslachus*.

3 de gen animal. 2 de gen. animal. cap. 3.

In præfat. in Opticum Euclidis. De triplici cœlo lib. 1. cap 4.

But there is another thing substituted in the place of this Element of fire, and maintained by ayre, and by minerall substances in the earth; which is neither an Element, nor a mixt body, nor any substance at all, but a mere quality: and this is preferred by most to bee the cause of the heat of our Bathes. And this is our common

mon kitchin fire, which is kindled by violent motion, maintained by fewell, without which it cannot subsist, and extinguished by his contrary. And although it may be deriued by communication or coition, as one candle lights another, yet originally it is kindled by violent motion, and what violent motion can there bee in the bowels of the earth to strike fire, or who shall bee the feweller? Exhalations and lightnings cannot do it, being aëreall meteors, and no more penetrable then the beames of the Sunne. And therefore although they may kindle a Vulcano vpon the surface of the earth, yet they cannot pierce deep, and their very reflection vpon the superficies of the earth takes away their strength: so as they can neither kindle new fire, nor communicate that which is kindled to any other fewell. For if it bee by communication or coition, that must bee by touch, *per contactum*, and then in the earth it can make but one fire, and not many, being not distinct in place, and must increase the heat: and then it will not keepe a constant tenor, as our Bathes doe.

Secondly for the nourishment of it, being a quality, it must haue a subiect, that is fewell, and it must haue meanes to vent the fuliginous vapours which it breeds in the dissolution of the fewell, lest they recoyle and quench the fire; as also there must be conueyance for the ashes which will fall downe continually vpon the fire, and quench it. Moreouer, by consuming such great quantities of Sulphur and Bitumen, and by mollifying and breaking of rocks, it would cause a great sinking of the earth in those places; as wee see in our Vulcanoes, where whole mountaines haue beene consumed and brought to euen ground.

Thirdly, this fire being a quality, is subiect to intention and remission, and to vtter extinguishment, not only

ly by want of fewell, which cannot bee regenerated where this actuall fire is, nor for want of vent, or choaking of ashes, &c. but also by reason of the abundance of water which the earth receiueth for the generations of Minerals, which being opposite to fire, would quench it. Wherefore we cannot rely vpon any subterraneall fire for the maintenance of our hot Bathes.

From the ayre this heat of Bathes cannot proceed, seeing it is neither hot in it selfe, as hath beene proued, nor can get any heat by motion, being of a thin liquid substance, which no attrition or collision can make hot. And as for aëreall meteors, bred from exhalations, and kindled, as is imagined, by an Antiperistasis: if they bee bred in the ayre, they are not able to penetrate into the bowels of the earth, as hath beene said before: if in the earth, besides the difficulty of finding roome enough for such plentifull exhalations as those must bee which procure lightning and thunder, and the vanity of their Antiperistasis to kindle these exhalations, as hath beene shewed before; it is a sufficient refutation to take away the subiect of the question, that is, all subterraneall fire, as I hope I haue done: and then wee need not dispute about the meanes of kindling it, &c. these momentany meteors being produced onely to kindle, and not to maintaine this fire.

From the water no man will deriue this fire, being a cold and moist Element, and apt to quench it: vnlesse it be by dilating the seminary spirits of naturall species: and then they concurre with vs, and renouncing the actuall fire, do confirme our heat of fermentation.

From the earth some haue imagined an inbred heat, *ingenitum terræ calorem*, whereby it seemes they had some glimmering of this light which wee haue giuen, but haue left it in as great obscurity as the Antiperista-

sis or Antipathy : and earth being a cold and dry Element, cannot be the cause of this heat, as it is earth.

So as it is manifest that naturally the Elements cannot procure this heat of Bathes ; and by violent motion they can do as little. For the earth being immoueable, cannot be stirred by any violent motion : and the other three Elements, as fire, ayre, and water, being thin and liquid substances, can procure no heat by any motion or collision either vpon themselues, or vpon the earth ; especially in the bowels of the earth, where all is quiet, and no roome or scope for any such motion as this must be. So that neither the other three Elements, nor the earth, either in the whole, or in the parts, can bee the cause hereof by any violent motion.

From mixt bodies if this heat come, it must bee from animals, vegetables, or minerals. Animals are not so plentifull in the earth as to cause this heat of Bathes, either aliue or dead. We read of subterraneall animals which haue both motion, and sense, and vnderstanding, in *Vincentius in speculo naturali*, in *Lactantius*, in *Agricola, de animantibus subterraneis*, in *Belloniu*, *Ortelius*, *Paracelsus*, *&c.* who cals them *Gnomi*, the Germanes *Bergmaenlin*, the French *Rabat*, the Cornishmen *Fayries*. The Danes are generally perswaded that there are such such creatures. But if any such liuing creatures be able to procure this heat, it cannot bee by their hot complexions, but it must be by violence and striking of fire. Perhaps *Democritus* hath hired them to make his lyme there, or some other to erect forges for thunder, lightning, and such like fire-works.

Bronteſq, Steropeſq, & nudus membra Pyracmon.

But these opinions deserue no confutation.

From dead animals in their putrefaction some heat may appeare, but such as neither for the degree, nor

for

for the continuance, can be answerable to our Bathes.

For vegetables there is the same reason as for dead animals : neither doth the earth breed such plenty of these in her bowels, as to procure a months heat to a tun of water, in one place.

Wherefore wee haue nothing to ground vpon but Minerall substances, whereof the earth affords enough.

For there is no part of the earth but is repleniſhed with minerall seeds. And although some may thinke that because minerals are not found, or not wrought in all places : and that some waters are also found which do not participate of the vertues of minerals, that therefore our hot Bathes proceed not from the fermentation of minerals, but from some other cause ; they are mistaken. For although metals are not frequent in some places, or at the least not discouered ; yet a man shall hardly dig ten foot deep in any place, but he shall finde rocks of stone, which haue their generation as well as other minerals, or some of the Salts, or *Bitumina*, or Spirits, or meane metals, &c. And how can Bathes receiue minerall qualities, but from minerals? Therefore where Bathes are, there must be minerals, although where minerals are, there are not alwayes Bathes. But perhaps they are not so accumulated, as by their contiguity they are able to yeeld any manifest heat ; their matter being disperſed as graines of corne sown in a field, which by reason of their lying single, do not shew a sensible heat in their fermentation; or most metals breeding between a Hanger and a Lieger, which *Agricola* cals *pendens* and *iacens*, are seldome aboue a foot thick, and therefore cannot yeeld much heat to our waters. And this is the cause why wee haue so few Bathes from Gold, Siluer, Tinne, Lead, &c. But where much matter is accumulated together, the very conti-

guity (one part lying vpon another) will make a manifeſt heat, vntill it grow to a *corpus continuum*, when the generation is perfected, and then the heat is extinguiſhed. Or perhaps they haue not water ſo plentifull as may yeeld a liuing ſpring, although they may haue ſufficient for the vſe of their generation. Or perhaps where they breake forth, they meet with deſert ſands, as in *Arabia, China, Affrica, &c.* which drink vp the water, and hinder the eruption of it. And whereas there are ſome hot ſprings found which do not ſhew any mineral quality in them, the reaſon of this may be the want of concrete iuyce, which, as I haue ſaid before, is the *medium* of communicating minerall qualities and ſubſtances with wateer. For without them, water is as vnapt to imbibe minerals, as it is to vnite with oyle. So as water may of it ſelfe receiue actuall heat from the fermentation of minerals, but not their qualities, without the mediation of ſome of the concrete iuyces: as contrariwiſe we finde ſome fountaines that receiue minerall qualities, and yet are cold: whereof I haue giuen many examples. The reaſon whereof is either for that they haue paſſed a long way, and by many Meanders from the place of generation to the place of their eruption, and ſo haue loſt their heat: or elſe the concrete iuyces, which will diſſolue in water without any heat, being impregnated with other mineals, do impart them to water, and yet without heat. But to ſay that there is any earth without minerall ſeeds, is to make a *vacuum in rerum natura*, and to deſtroy the vſe of the Elements. It is true that the ſeeds do not alwayes meet with opportunity to diſplay themſelues, and ſomtimes they are faine to ſerue vnder other colours, which are more predominant: but there is no part of the earth without ſome ſeeds or other.

And

And from hence wee muſt deriue the originall of the actuall heat of Bathes : for nothing elſe in the world will ſerue our turn to procure ſo laſting and ſo vniforme a heat vnto them : and that not by kindling any actuall fire about them, For moſt of our minerals whereof our Bathes conſiſt, and from whence they receiue both their actuall heat and virtues, will not burne, neither haue any actuall heat in themſelues, being all cold to the touch, but receiue it by a fermenting heat which they haue in their generatiõn : without which there is no generation for any thing. And this heat continues ſo long as the work of generation continues : which being once begun, doth not ceaſe in many ages, by reaſon of the plenty of matter which the earth yeelds, and the firmneſſe and ſolidity thereof. And although after that the minerals haue attained to their perfection, this heat ceaſeth, yet the generation extends further then where it firſt began, and enlargeth it ſelfe euery way, the works of nature being circular : ſo as the water which was heated by the firſt generation, cannot avoid the other ſucceeding generations, but muſt meet with them either behind or before, beneath or aboue, on the one ſide, or on the other (eſpecially ſeeing no generation can proceed without water :) and yet keepes the ſame tenor and degree of heat, according to the nature of the minerals fermenting, and to the diſtance from the place of eruption. And this is a farre more probable cauſe of the continuance of our Bathes, then any ſubterraneall deſtructiue fire can be, or any other of the ſuppoſed cauſes can yeeld. I do not deny but that hot Bathes may ceaſe and become cold ; as *Ariſtotle* ſaith[2] of ſalt fountaines which are cold, that they were once hot, before the originall of their heat was extinct : which I interpret to bee when the work of generation

[2] *Meteorol. 2.*

ceaſed, and the ſalt brought to his perfection. But I do not read of any hot Bathes that haue ceaſed: vnleſſe neere vnto ſome Vulcano, where either the ſincking of rocks hath altered the courſe of them, as at Tripergula and Baia, or the flaming fire which heated them at their eruption being extinguiſhed, as in the Æolian Ilands. Theſe Vulcanoes are farre more ſubiect to decay then our generatiue heat, becauſe they conſume their fewell; this doth not, but increaſeth it daily, *vireſq; acquirit eunde.* Of the other *Ovid* ſaith,

Nec quæ ſulphureis ardet fornacibus Ætna
Ignea ſemper erit; neq; enim fuit ignea ſemper.

But of this we can hardly bring an Inſtance of any that haue decayed; becauſe where a generation is begun, there ſeldome or neuer wants matter to propagate and enlarge it. And ſeeing minerals haue not their ſeeds in their indiuiduals, as animals and vegetables haue, but in their wombs, as hath been ſhewed before; it were to bee feared that there would be a decay of minerall ſpecies, and ſo a *vacuum* left in nature, if theſe generations ſhould be no more durable then the other. Animals are propagated by begetting of their ſpecies, the power whereof is in euery indiuiduall, which, no donbt, will not giue ouer this trade as long as the world laſteth. Vegetables are alſo fruitfull in their kinds, euery one producing 100, or perhaps 1000 ſeeds of indiuiduals yeerly, to perpetuate their ſpecies. Minerals haue no ſuch meanes, but onely haue their ſeedes in their wombs, whereby they are propagated: and if theſe generations, being longer in perfecting of their ſpecies, were not ſupplied with a larger extent for their productions; nature had been defectiue in not prouiding

ſufficient

sufficient meanes for their perpetuity, as well as for others, and might easily suffer a decay, and a vacuity of minerall species; which agrees not with the prouidence of nature, and the ornament of the world. The necessity hereof depends vpon the first benediction, *(crescite & multiplicamini)* which, no doubt, belongs as well to minerals in their kinds, as it doth to animals and vegetables, and by virtue hereof wee see that they are propagated daily, as I haue proued before Cap. 11. And this is that necessity whereof *Hippocrates* speaks, and that *fatum naturale inhærens rebus ipsis*, as *Lipsius* saith; and that *Lex Adrastiæ* mentioned by *Aristotle* and *Galen locis ante citatis*, so firmly established, as nothing can contradict it. Arithmetick, Geometry, & Logick, which are but attendants vpon nature, haue their principles so firmly grounded, as nothing can shake them; and shall wee think that nature it selfe is grounded vpon weaker foundations? wherefore we need not doubt of the perpetuity of these generations, but that as some parts attain to their perfection, so other parts will bee alwayes *in fieri* or *in via ad generationem*: whereby our Bathes will neuer faile of their heat or their virtues.

Trismegistus in Asclepio. c. 7. & In Pimandro c. 1.

Lib. de constant.

This I hope is sufficient for the confuting of other opinions, and the clearing of mine owne from all absurdities, concerning the degree of heat, which is as much as the nature of water can endure without vtter dissipation: concerning the equall tenor of the heat; the duration of it; the participation of minerall qualities, &c. The other kind of confirmation which wee call Apodeicticall, is also here and there dispersed in this Discourse: as that all minerals haue their continuall generation: that this generation is not without heat and moysture, which do necessarily attend all generations:

that

that few minerall ſubſtances or qualities can bee imparted to water, but whileſt they are in generation, and yet we find them much impregnated with them : that our Miners do find an actuall heat, and in a high degree, in the digging of minerals, where the fermentation is not throughly extinct : that wee obſerue the like courſe of nature in the generations of animals and vegetables : that we are led to the acknowledgement hereof by many artificiall concluſions, and artifices &c. Wherefore I forbeare to make any larger repetition hereof.

And this is in briefe (though plainly deliuered) my opinion concerning the actuall heat of Bathes, and of the minerall qualities which we find in them ; which I refer to the cenſures of thoſe that be learned.

There are two other motions which reſemble this fermentation The one is *Motus dilatationis*, the other *Antipatheticus*. *Motus dilatationis* is euident in Lime, in Allum, in Copperas, and other concrete iuyces, whereby the affuſion of water, the Salt in the Lyme, or the concrete iuyces being ſuddenly diſſolued, there is by this motion, an actuall heat procured for a time, able to kindle any combuſtible matter put to it.

The like we obſerue in thoſe ſtone Coales, called metall Coales, which are mixed with a Marcheſit containing ſome minerall iuyce, which receiuing moyſture, doth dilate it ſelfe, and growes ſo hot, as oftentimes great heapes of thoſe Coales are kindled thereby, and burnt before their time ; as hath beene ſeene at Puddle Wharfe in London, and at Newcaſtle. But this is much different from our fermentation.

Another *Motus* reſembling this fermentation, is that which is attributed to Antipathy, when diſagreeing ſubſtances being put together, do fight, and make a manifeſt actuall heat ; as Antimony and Sablimat, oyle of Vitrioll,

Vitrioll, and oyle of Tartar, Allum liquor and Vrine, Lees, Chalk,&c. But the reason of this disagreement is in their Salts, whereof one is astringent, the other relaxing; the one of easie dissolution in water, the other of hard dissolution,&c. where one minerall hinders the dissolution or congelation of another: and not by reason of any antipathy: for it is not likely that nature would produce two contrary substances mixed like atomes in one subiect, but that in their very generations the one would bee an impediment to the other. So in vegetables where one plant sucks away the nourishment from another, we call it antipathy. But if we examine aright what this sympathy and antipathy is, we shall finde it to bee nothing but a refuge of ignorance, when not being able to conceiue the true reasons of such actions and passions in naturall things, wee fly sometimes to indefinite generalities, and sometimes to this inexplicable sympathy and antipathy: attributing voluntary, and sensitiue actions and passions to insensible substances. This *motus* also is much different from fermentation, as may easily appeare by the former description. And thus much for this point of fermentation, which I hope will giue better satisfaction then any of the former opinions.

Cap. 15.

By what meanes it may be discouered what minerals any water containeth.

THe nature of minerals and their generations being handled, and from thence the reasons drawne, both of the actuall heat of Bathes, and of their qualities: Now it is fit we should seeke out some meanes how to

discouer what minerals are in any Bath, that thereby we may the better know their qualities, and what vse to make of them for our benefit. Many haue attempted this discouery, but by such weake meanes, and vpon such poore grounds, as it is no meruaile if they haue failed of their purpose: for they haue contented themselues with a bare distillation or euaporation of the water, & obseruing the sediment, haue thereby iudged of the minerals, vnlesse perhaps they finde some manifest taste, or smell, or colour in the water, or some vnctuous matter swimming aboue it. Some desire no other argument of Sulphur and Bitumen, but the actuall heate: as though no other minerals could yeeld an actuall heate, but those two. But this point requires better consideration; and I haue beene so large in describing the natures and generations of minerals, because without it, wee cannot discerne what minerals we haue in our waters, nor iudge of the qualities and vse of them.

Our Minerals therefore, are either confused or mixed with the water. If they bee confused they are easily discerned: for they make the water thick and pudly, and will either swim aboue, as Bitumen will doe, or sink to the bottome, as earth, Sulphur, and some terrestriall iuyces; for no confused water will remaine long vnseparated. If they are perfectly mixed with the water, then their mixture is either corporall, where the very body of the Minerall is imbibed in the water, or spirituall, where either some exhalation, or spirit, or tincture is imparted to the water.

Corporally there are no minerals mixed with water, but iuyces, either liquid, as *succus lapidescens, metallificus*, &c. before they are perfectly congeled into their naturall consistence, or concrete, as Salt, Niter, Vitriol, and Allum. And these concrete iuyces do not only dis-

solue

ſolue themſelues in water, but oftentimes bring with them ſome tincture or ſpirit from other Minerals. For as water is apt to receiue iuyces, and tinctures, and ſpirits from animals, and vegetables; ſo are concrete iuyces, being diſſolued, apt to extract tinctures and Spirits from minerals, and to communicate them with water. And there are no Mynes, but haue ſome of theſe concrete iuyces in them, to diſſolue the materials of them, for their better vnion and mixture: and there are few minerals or metals, but haue ſome of them incorporated with them: as we ſee in Iron, and Copper, and Tinne, and Leade, &c. And this is the reaſon that water being long kept in Veſſels, of any of theſe metals, will receiue a taſte and ſmell from them, eſpecially if it be attenuated, either by heate, or by addition of ſome ſoure iuyce; and yet more, if the metals be fyled into powder as we ſee in making Chalibeat wine, or Sugar of Leade, or Puttie from Tinne, or Verdegreaſe from Copper. There may be alſo a mixture of Spirituall ſubſtance from minerals, whilſt they are in generation, and *in Solutis principijs*: the water paſſing through them, and the rather if it bee actually hot, for then it is more apt to imbibe it, and will containe more in it, being attenuated by heate, then being cold; as we ſee in Vrines, which though they bee full of humours, yet make no great ſhew of them ſo long as they are warme, but being cold, do ſettle then to the bottome.

Theſe ſpirituall ſubſtances are hardly diſcerned in our Baths, but by the effects; for they leaue no reſidence after euaporation; and are commonly as volutill in ſublimation as the water it ſelfe: neither doe they encreaſe the weight of the water, nor much alter the taſte or ſmell of them, vnleſſe they be very plentifull. Wherefore we haue no certaine way to diſcouer them, but by

the effects. We may coniecture somwhat of them by the Mynes which are found neare vnto the Baths, and by the mud which is brought with the water. But that may deceiue, as comming from the passages through which the water is conueyed, or, perhaps, from the sweat and strigments of mens bodyes which bathe in them. The corporall substances are found, either by sublimation or by precipitation. By Sublimation, when being brought to the state of congelation, and sticks of Wood put into it, within a few dayes, the concrete iuyces will shoote vpon the wood; in Needles, if it bee Niter; in squares, if it be Salt; and in Clods and Lumps, if it be Allum or Coperose, and the other minerall substance which the waters haue receiued, wil either incorporate a tincture with them, or if it be more terrestriall, will settle and separate from it, and by drying it at a gentle fire, will shew from what house it comes, either by colour, taste, smell, or vertue: There is an other way by precipitation, whereby those minerall substances are stricken downe from their concrete iuyces which held them, by addition of some opposite substance. And this is of two sorts: either Salts, as Tartar, Soape-Ashes, Kelps, Vrine, &c. Or sowre iuyces as Vinegar, Lymons, Oyle of Vitrioll, Sulphur, &c. In which I haue obserued that the Salts are proper to blew colours, and the other to red: for example, take a piece of Scarlet cloath, and wet it in Oyle of Tartar (the strongest of that kinde) and it presently becomes blew: dip it againe in Oyle of Vitriol, and it becomes red againe. *Penotus* hath a strange precipitating water from tin, mercury, alkali, &c. which separate any minerals, *Fides sit penes authorem.*

These are the chiefe grounds of discouering minerall waters, according to which any man may make tryall

of

of what waters he pleaſeth. I haue beene deſirous heretofore to haue attempted ſome diſcouery of our Bathes, according to theſe principals: but being thought (by ſome) either not conuenient, or not vſefull, I was willing to ſaue my labour, which perhaps might haue ſeemed not to be worth thankes: and in theſe reſpects am willing now alſo to make but a bare mention of them.

Cap. 16.

Of the vſe of Minerall waters, inwardly, outwardly. In this Chapter is ſhewed the inward vſe of them, firſt in generall; then particularly of the hot waters of Bathe.

THe nature and generations of Minerals being handled, and how our Minerall waters receiue their impreſſions, and actuall heat from thence; and by what meanes they are to be tried, what Minerals are in each of them. Now we are to ſhew the vſes of them; which muſt bee drawne from the qualities of the Minerals whereof they conſiſt: which are ſeldome one or two, but commonly moe. Theſe qualities are either the firſt, as hot, cold, moyſt, & dry; or the ſecond, as penetrating, aſtringent, opening, reſoluing, attracting, clenſing, mollifying, &c. For the firſt qualities, it is cereaine and agreed vpon by all Authors; That all Minerall waters do dry exceedingly, as proceeding from earth; but ſome of thoſe doe coole withall, and ſome do heat.

Cooling waters are good for hot diſtemperatures of the liuer, ſtomach, kidneyes, bladder, wombe, &c. Alſo for ſalt diſtillations, ſharp humors, light obſtructions of the Meſaraicks, &c.

Heating waters are good for cold affects of the ſtomach, bowels, wombe, ſeminary veſſels, cold diſtillations, Palſyes, &c.

For the ſecond qualities, clenſing waters are good in all vlcers, eſpecially of the guts.

Mollifying waters, for all hard and ſchirrous tumors.

Aſtringent waters, for all fluxes, &c. and ſo of the reſt.

Now theſe waters are vſed either inwardly or outwardly.

Inwardly, either by mouth, or by iniection.

By mouth, either in potion, or in broaths, iuleps, &c.

6 de tuenda ſanitate cap. 9. *Galen* neuer vſed thsm inwardly, becauſe hee iudged their qualities to bee diſcouered by experience, rather then by reaſon. And ſeing wee finde many of them to be venomous, and deadly, as proceeding from Arſenick, Sandaracha, Cadmia, &c. we had need bee very wary in the inward vſe of them.

Neptunes Well in Tarracina was found to be ſo deadly, as it was therefore ſtopped vp. By Monpellier at Perant is a Well which kils all the fowles that drink of it; the lake Auernus kils the fowles that fly ouer it; ſo doth the vapour ariſing from Charons den between Naples and Puteolum. So there are diuers waters in Sauoy and Rhetia, which breed ſwellings in the throat. Others proceeding from Gipſum doe ſtrangle, &c. But where wee finde waters to proceed from wholſome Minerals, and ſuch as are conuenient, and proper for our intents, there wee may bee bold to vſe them as well inwardly as outwardly: yet ſo as wee doe not imagine them to bee ſuch abſolute remedies, as that they are of themſelues able to cure diſeaſes without either rules for the vſe of them, or without other helps adioyned to them. For

as

as it is not enough for a man to get a good Damasco or Bilbo blade to defend himselfe withall, vnlesse he learne the right vse of it from a Fencer ; so it is not enough to get a medicine and remedy for any disease, vnlesse it bee rightly vsed, and this right vse must come from the Physitian, who knows how to apply it, & how to prepare the body for it, what to adde and ioyne with it, how to gouerne and order the vse of it, how to preuent such inconueniences as may happen by it, &c.

Wherefore, where we speake of any Minerall water, or of any other medicine that is proper for such & such a griefe, we must be so vnderstood, that the medicine is not wise enough to cure the disease of it selfe, no more then a sword is able of it selfe to defend a man, or to offend his enemy, but according to the right and skilfull vse of it. And as it is not possible for a Fencer to set down absolute rules in writing for his Art, whereby a man may be able in reading of them to defend himselfe ; no more is the Physitian possibly able to direct the particular vses of his remedy, whereby a patient may cure himselfe without demonstration and the particular direction of the Physitian. It is true, that we haue generall rules to guide vs in the cure of diseases, which are very true and certaine ; yet when we come to apply them to particular persons, and seuerall constitutions, these generall rules are not sufficient to make a cure, but it must be varied according to circumstance. Hereupon wee daily finde, that those patients which think to cure themselues, out of a little reading of some rules or remedies, are oftentimes dangerously deceiued. And this is enough to intimate generally concerning the vses of our Minerall waters.

Inwardly we finde great and profitable vse of such waters as proceed from Niter, Allum, Vitrioll, Sulphur, Bitumen,

Bitumen, Iron, Copper, &c. Examples whereof I haue set downe before in the seuerall minerals, referring the particular vses of each to such Authors as haue purposely described them.

My intent is chiefely to apply my selfe to those Bathes of *Bathe* in Summersetshire; which consisting, as I iudge, principally of Bitumen, with Niter, and some Sulphur, I hold to bee of great vse both inwardly and outwardly. And I am sorry that I dare not commend the inward vse of them as they deserue, in regard I can hardly bee perswaded that wee haue the water pure, as the springs yeeld them, but doe feare, lest where wee take them, they may bee mixt with the water of the Bath. If this doubt were cleared, I should not doubt to commend them inwardly, to heat, dry, mollifie, discusse, glutinate, dissolue, open obstructions, cleanse the kidneyes, and bladder, ease cholicks, comfort the matrix, mitigate fits of the mother, helpe barrennesse proceeding from cold humors, &c. as *Tabernemontanus* affirmes of other Bituminous Bathes. Also in regard of the Niter, they cut and dissolue grosse humors, and cleanse by vrine. In regard of the Sulphur, they dry and resolue, and mollifie, and attract, and are especially good for vterine effects proceeding from cold and windy humors.

Thesauri aquarij pag. cap. 40.

And I would wish these waters to bee drunk hot as they are, for better penetration, and lesse offence to the stomach. The ancient Grecians and Romans did drink most of their water and wine hot, as we finde in many Authors, which *Salmuth* hath diligently collected: and *Anthonius Percius* hath purposely written a booke of it, entituled, *Del bever caldo costumato da gli Antichi.* Wee finde also that it is in vse at this day, both in the East Indies and in Turkey, where they haue a drinke

In Panciroll. de deperditis pag. 540.

called

called *Capha*, sold ordinarily in Tauerns, and drunke hot, although in the Summer. *Verulamius* doth maruell that it is so much growne out of vse, and aduiseth to drinke our first draught at our meales, hot. There is great reason for it, both for preseruation of health, and for cure of many diseases. The stomach being a neruous part, must needs bee offended by that which is actually cold: and being the seat of naturall appetite, and of the first concoction (whose errors and defects are not amended in the other concoctions) had need to be preserued in his natiue vigour and strength, that it may breed good nourishment for the whole body. But the much vse of cold drink, although it seeme to refresh vs for the present, by dulling the appetite & the sense of thirst and hunger, as a stupefactiue narcotick will doe: yet it destroyes the faculties of the stomach, which are maintained and quickned by heat: and thereby breeds crudities in our bodies, from whence many diseases proceed. The East Indians are seldome troubled with the Stone or the Gowt, and it is imputed to their warme drink: the like wee may iudge of obstructions, collicks, dropsies, rhewmes, coughs, hoarsnesse, diseases in the throat and lungs, &c. in which cases, and many moe which proceed from ill concoction and crudity of humours, no doubt it is an excellent preseruatiue to drink our drink warm. I know a worthy Gentleman of excellent parts, who in his trauailes obserued the benefit hereof, and for many yeeres hath vsed to take his drink hot: and being now aboue 80 yeeres old, enioyeth his heath of body, and vigour of spirits, beyond the ordinary course of men of his age. Likewise in the cure of diseases I perswade my selfe it would proue very profitable, if it were in vse. For example in feuers, I see no reason but it would doe more good then our cold wa-

Prosper. Alpinus de medic. Ægyptiorum l. 4. c. 3. De vita & morte pag. 304.

I. W.

ters, iuleps, posset drinks, &c. which I approue well of, but if the patient did drinke them hot, the stomach would be lesse offended thereby, the moysture (which we chiefly desire in them) would penetrate more, and the euentilation by sweat or insensible transpiration, would not be hindered. *Hippocrates* is very plaine in this point, and reckons many inconueniences of cold drinks, to the teeth, bones, nerues, breast, back, lungs, stomach, &c. I will not insist longer hereupon, being a practicall point of Physick : only I thought good to intimate it to our learned Physitians to contemplate vpon, for the benefit of our patients.

Lib. de humidorum usu.

Our Bath Guides do vsually commend the drinking of this water with salt to purge the body, perswading the people, that the Bath water hath a purging quality in it, when as the same proportion of spring water, with the like quantity of salt will do the like. Our Baths haue true virtues enough to commend them, so as wee need not seek to get credit or grace vnto them by false suggestions. The Bitumen and Niter which is in them, although it serues well for an alteratiue remedy, yet it is not sufficient for an euacuatiue : and therefore wee must attribute this purgatiue quality, either to the great quantity of water which they drinke (and so it works) *ratione ponderis)* or vnto the stimulation of salt which is dissolued in it, or vnto both together. Our common salt hath a stimulating qnality, as is shewed before Cap. 7. and *Erastus* saith that it purgeth much. *Bulcasis* giues it to that purpose from ʒ *ij* to ʒ *iiij*. *Mesne* also prescribes it to purge grosse humors, & so doth *Auicen.* Wherfore there is no doubt but salt will purge of it selfe, being dissolued in our Bath water. But I should like much better to dissolue in it some appropriate sirrup or other, purgatiue, for this purpose, as Manna,

Simpl. cap. 16. lib. 5 sum. 1. tract. 4. & lib. 2. tract. 2. cap. 624

Tartar,

Tartar, Elaterium, sirrups of Roses, of Cicory, with Rhewbarb, Augustunus : or to moue vrine, *Syr. de 5. rad. Bizantinus de Limonibus, Sambucinus, de Althea, &c.* And this course is usuall in Italy, according as the Physitian sees most conuenient, but with this caution, that when they take it in potion, they must not vse the Bath, because of contrary motions.

Inwardly also Bath waters are vsed, for Broths, Beere, Iuleps, &c. although some doe mislike it, because they will not mixe medicaments with aliments : wresting a text in *Hippocr.* to that purpose. But if wee may mixe Diureticks, Deoppilatiues, Purgatiues, &c. with aliments, as vsually we doe : I see no reason but we may as well vse minerall waters, where wee desire to make our aliments more alteratiue by a medicinall quality alwaies prouided that there be no malignity in them, nor any ill quality which may offend any principall part. And thus much for the vse of them by mouth. *Baccius lib. 2. Claudinus p. 377 De aere aquis & locis.*

By iniection they are vsed also into the Womb, to warme, and dry, and cleanse those parts ; into the passages of vrine, to dry and heale excoriations there : into the fundament for like causes, as also for resolutions of the Sphincter, and bearing downe of the fundament, &c. And thus they are vsed either alone, or mixed with other medicines, according as the Physitian thinks most fit, and wee daily finde very good successe thereby in vterine affects, depending vpon cold causes. Thus much for the inward vse of our Bath waters.

Cap. 17.

Of the outward vse of the hot waters of Bathe ; first, the generall vse of them to the whole body in bathing: secondly, the particular vse of them by pumping, bucketing, or applying the mud.

OVtwardly our Bath waters are principally vsed, becauſe they are moſt properly for ſuch effects as are in the habit of the body, and out of the veines : As Palſies, Contractions, Rheumes, cold tumors, affects of the skin, aches, &c. And in theſe caſes wee vſe not only the water, but alſo the mudde, aud in ſome places the vapour.

The water is vſed both for his actuall and potentiall heat, as alſo for the ſecond qualities of mollifying, diſcuſſing, clenſing, reſoluing, &c. which the minerals giue vnto it. The vſe hereof is either generall to the whole body, as in bathing ; or particular to ſome one part, as in bucketing or pumping, which ancienly was called *Stillicidium.* The Italians call it *Duccia*. The generall vſe in bathing, is moſt ancient : for our Bathes were firſt diſcouered thereby to bee wholſome and ſoueraigne in many diſeaſes.

Nechams verſes concerning the vſe of theſe Bathes, are foure ſundred yeeres old.

Bathoniæ Thermas vix præfero Virgilianas
Confecto proſunt Balnea noſtra ſeni :
Proſunt attritis, colliſis inualidiſque,
Et quorum morbis frigida cauſa ſubeſt.

Which I will Engliſh out of Maſter Doctor *Hackwels* learned work of the perpetuity of the world.

Our

Our Baynes at Bathe with *Virgils* to compare;
For their effects, I dare almoſt be bold,
For feeble folke, and crazie good they are,
For bruis'd, conſum'd, farre ſpent, and very old,
For thoſe likewiſe whoſe ſickneſſe comes of cold.

We haue antient traditions (*fama eſt obſcurior annis*) That King *Bladud* who is ſaid to haue liued in the time of *Elias*, did firſt diſcouer theſe Bathes, and made tryall of them vpon his owne ſonne, and thereupon built this City, and diſtinguiſhed the Bathes, &c. But we haue no certaine record hereof. It is enough that wee can ſhew the vſe of them for 400 yeares, and that at this day they are as powerfull as euer they were: *Camden* giues them a more ancient date from *Ptolomy* and *Antonin*, and the Saxons: and ſaith they were called *Aquæ Solis*, and by the Saxons *Akmanchester*, that is, the towne of ſicke people, and dedicated to *Minerua*, as *Solinus* ſaith. The opinion that the Bathes were made by Art, is too ſimple for any wiſe man to beleeue, or for me to confute: And *Necham* in his verſes which follow after thoſe I haue mentioned, doth hold it a figment: you may ſee them in *Camden*. We haue them for their vſe in bathing, diſtinguiſhed into foure ſeuerall Bathes, whereof three haue beene anciently: namely the Kings Bath, the hot Bath, and the Croſſe Bath. The Queenes Bath was taken from the Springs of the Kings Bath, that being farther off, from the hot Springs, it might ſerue for ſuch as could not endure the heate of the other. We haue likewiſe an appendix to the hot Bath, called the Leapers Bath, for vncleane perſons. We finde little difference in the nature of theſe Bathes, but in the degree of heate, proceeding no doubt, from one and the ſame Myne. Yet as the Myne may be hotter in one part then in an

other, or the passages more direct from it, so the heate of them may vary. Some little difference also we finde among them, that one is more cleansing then another, by reason (as I take it) of more Niter. For in the crosse Bath we finde that our fingers ends will shrinke and shriuell, as if we had washed in Soape water, more then in the other Bathes. The Kings Bath, as it is the horteſt of all the Bathes, so it is the fitteſt for very cold diseases, and cold and plegmaticke constitutions: And we haue daily experience of the good effects it worketh vpon Palsies, Aches, Sciaticaes, cold tumours, &c. both by euacuation, by Sweate, and by warming the parts affected, attenuating, discussing, and resoluing the humors: Also in Epilepsies and Vterin affects in the Scorbut, and in that kind of dropsie which wee call Anasarca. The hot Bath is little inferiour vnto it, as next in degree of heate, and vsefull in the same cases: The Queenes Bath, and Crosse Bath are more temperate in their heate, and therefore fitteſt for tender bodies, which are apt to bee inflamed by the other, and where there is more neede of mollifying and gentle warming, then of violent heate and much euacuation by sweate. And in these Bathes they may indure longer without dissipation of Spirits, then in the other: the Queenes Bath is the hotter of the two, but temperate enough for most bodies. The Crosse Bath is the coldeſt of all, as hauing but few Springs to feede it: yet wee obserue it to supple, and molifie more then the reſt, both because they are able to stay longer in it, and because (as I said before) it seemes to participate more with Niter, then the reſt, which doth cleanse better, and giues more penetration to the other Minerals. Wherefore in contractions, Epilepsies, Vterin affects, Conuulsions, Cramps, &c. This Bath is very vsefull, as also in cutaneall diseases, as Morphewes,

Itch,

Itch, &c. Thus much for the nature and difference of our Bathes, and the generall vse in bathing.

They are vsed also to particular parts by pumping or bucketting, or applying the mud.

Pumping or bucketting are not vsed in that fashion, as we vse them, in any other Baths that I can learn, but only the Duccia or Stillicidium: But I hold our fashion as good as that. The water comes more plentifully vpon the part, and may be directed as the patient hath occasion. Our bucketing hath beene longest in vse: but finding that it did not heat some sufficiently, being taken from the surface of the Bath, wee haue of late erected Pumps, which draw the water from the springs or neare vnto them, so as wee haue it much hotter from thence, then wee can haue it by bucketing. A worthy Merchant and Citizen of London, M. *Humphrey Browne*, was perswaded by me to bestow two of these Pumpes vpon the Kings and Queenes Bath, whereby hee hath done much good to many, and deserues a thankfull remembrance. The like also I procured to be done at the other Baths, although that of the Crosse Bath is not so vsefull, by reason it wants heat, vnlesse for yong children. Also wee haue a Pump out of the hot Bath, which wee call the dry Pump, where one may sit in a chaire in his cloathes, & haue his head, or foot, or knee pumped without heating the rest of the body in the Bath; and deuised chiefely for such as haue hot kidneys, or some other infirmities which the Bath might hurt. This we finde very vsefull in rheumes, and cold braines, and in aches and tumors in the feet. For these Pumps we are beholding vnto the late Lord Archbishop of Yorke, and to M. *Hugh May*, who vpon my perswasions were contented to bee at the charge of them. It were to bee wished that some well disposed

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to the publike good, would erect the like at the Kings Bath, where, perhaps, it might bee more vſefull for many, in regard of the greater heat which thoſe ſprings haue.

The lute of Baths is in much vſe in ſome places, where it may be had pure, both to mollifie, and to reſolue, and to ſtrengthen weake parts. But we make little vſe of it in our Baths, becauſe we cannot haue it pure, but mixed with ſtrigments. In diuers other places either the ſprings ariſe a good diſtance from the bathing places, or elſe there be other eruptions from whence it may be taken. But our ſprings ariſing in the Bathes themſelues, it cannot well be ſaued pure. Beſides, we haue not thoſe meanes of the heat of the Sunne, to keepe it warme to the parts where it is applied: ſo as growing cold, it rather does hurt then good. Wherefore it were better for vs, to vſe artificiall lutes, as the Ancients did, of clay, Sulphur, Bitumen, Niter, Salt, &c. or vnguents of the ſame nature, as that which they call Ceroma. But the beſt way is to referre the election of theſe remedies to the preſent Phyſitian, who will fit them according to the nature of the griefe.

Cap. 18.

In what particular infirmities of body, bathing in the hot waters of Bathe is profitable.

TO come more particularly to the vſe of bathing, we muſt vnderſtand, that there are many minerall waters fit for bathing, which are not fit to drinke: as thoſe which participate with Lead, Quickſiluer, Gypſum, Cadmia, Arſenick, &c. Alſo thoſe that containe liquid Bitumen, are thought to relaxe too much: but

thoſe

thoſe that proceed from dry Bitumen are permitted, and preſcribed in potion by *Paulus Ægineta*, and *Trallian*: Sulphur alſo is queſtioned, whether it bee fit to bee taken inwardly by potion, becauſe it relaxeth the ſtomach, and therefore *Aetius* forbids it: yet *Trallian* allowes it, and ſo do others, if the Sulphur be not predominant. But for outward bathing there is no queſtion to bee made of theſe Minerals, nor of any other which are not in themſelues venomous. And whereas *Oribaſius*, *Ægineta*, *Actuarius*, *&c.* are ſuſpicious of Sulphur and Bitumen for the head: they muſt bee vnderſtood of hot diſtempers there, and not of cold rheumatick braines; where by daily experience wee finde the profitable vſe of them, both by euacuation in bucketing, and by warming and comforting the cold part. And *Oribaſius* doth ingenuouſly confeſſe, that the nature of theſe Baths was not then perfectly diſcouered: and therefore they were all held to bee, not only dry, but very hot: although wee finde them not all ſo: for Iron waters doe coole, and ſo doe thoſe of Campher, and Alluminous, and Nitrous waters alſo. But for our Bituminous and Sulphurous waters which *Galen* forbids in hot braines, there is no reaſon to ſuſpect them in cold effects of the braine and nerues, in which caſes we make eſpeciall choyce of all things, which either in taſte or ſmell doe reſemble Bitumen: as Rue, Caſtorium, *Valeriana*, *herba paralyſeos*, *trifolium*, *aſphaltitis*, *&c*; which both by his warming quality, and by his ſuppling and mollifying ſubſtance, is moſt proper and conuenient for thoſe parts. The like I may ſay of Sulphur, in which nothing can bee excepted againſt, but his ſharp ſpirit, which is made by burning: and wee haue none of that in our waters, nor, I hope, any fire to make it withall. The other parts of Sulphur are hot

1 *Tetrab. ſerm.* 3 *cap* 167. *Trallian. l.* 10. *c.* 1

Orib. l. 10. *c.* 3. *Ægin. l.* 1. *c.* 52. *Actuar. l.* 3. *c.* 10.

Cap. 5.

Hippoc. de aere, aquis, & locis.

6 *de tuenda ſanitate cap.* 9.

and dry, and very vnctuous. As for Niter, it clenseth, purgeth both by stoole and vrine, and helpeth the incorporation of the other Minerals with the water, and qualifies the heat of them, and giues them better penetration into our bodies. In regard of these Minerals, together with the actuall heat, wee finde that the bathing in our Baths doth warme the whole habit of the body, attenuate humors, open the pores, procure sweat, moue vrine, clense the matrix, prouoke womens euacuations, dry vp vnnaturall humors, strengthen parts weakned, comfort the nerues, and all neruous parts, cleanse the skin, and suck out all salt humors from thence, open obstructions if they be not too much impacted, ease paines of the ioynts, and nerues, and muscles, mollifie and discusse hard tumors, &c. Wherefore this bathing is profitable for all palsies, apoplexies, caros, epylepsies, stupidity, defluctions, gouts, sciaticaes, contractions, cramps, aches, tumors, itches, scabs, leprosies, collicks, windines, whites in women, stopping of their courses, barrennesse, obortions, scorbuts, anasarcaes, and generally all cold and phlegmatick diseases, which are needlesse to reckon vp. In all which cures our Bathes haue a great hand, being skillfully directed by the Physitian, with preparation of the body before, and addition of such other helps as are needfull. And whereas without the help of such Baths these diseases could not be cured without tormenting the body, either by fire, or launcing, or caustick, or long dyets, or bitter and vngratefull medicines, &c. In this course of bathing all is pleasant and comfortable, and more effectuall then the other courses, and therefore it is commonly the last refuge in these cases, when all other meanes faile. I will not vndertake to reckon vp all the benefits which our Baths doe promise; but if we had a register kept of the

manifold

manifold cures which haue been done by the vse of our Bathes principally, it would appeare of what great vse they are. But as there is a defect in not keeping a Catalogue of rare Cures, so many persons of the better sort would be offended if a Physitian should make any mention of their cures or griefes : wherefore I must speake but generally.

Cap. 19.

The manner of bathing, chiefly referred to the inspection and ordering of a Physitian. Yet some particulars touched, concerning the gouernment of the patient in and after bathing : the time of day, of staying in the Bath, of continuing the vse of it. The time of the yeere. Of couering the Baths.

NOw for the manner of bathing, I will not set down what the Physitian is to doe, but leaue that to his iudgemeut and discretion : but what is fit for the patient to know : for there are many cautions and obseruations in the vse of bathing, drawne from the particular constitutions of bodies ; from the complication of diseases, and from many other circumstances which cannot be comprehended in generall rules, or applied to all bodies alike : but many times vpon the successe, and the appearing of accidents, the Physitian must *ex re nata capere consilium*, and perhaps alter his intended course, and perhaps change the Bath either to a hotter or cooler, &c. In which respect, those patients are ill aduised which will aduenture without their Physitian vpon any particular Bath, or to direct themselues in the vse of it: And this is a great cause that many goe away from hence without benefit, and then they are apt to

complaine of our Bathes, and blaſpheme this great bleſſing of God beſtowed vpon vs.

It is fit for the patient when hee goeth into the Bath, to defend thoſe parts which are apt to bee offended by the Bath: as to haue his head well couered from the ayre and winde, and from the vapours ariſing from the Bath: alſo his kidneyes (if they be ſubiect to the Stone) anoynted with ſome cooling vnguents; as *Roſatum comitiſſæ, infrigidans Galeni, ſantolinum, &c.* Alſo to begin gently with the Bath, till his body bee inured to it, and to bee quiet from ſwimming, or much motion, which may offend the head by ſending vp vapours thither: at his comming forth, to haue his body well dryed, and to reſt in his bed an houre, and ſweat, &c.

A morning houre is fitteſt for bathing, after the Sun hath bin vp an houre or two; and if it be thought fit to vſe it againe in the afternoone, it is beſt foure or fiue houres after a light dinner. For the time of ſtaying in the Bath, it muſt be according to the quality of the Bath, and the toleration of the patient. In a hot Bath, an houre or leſſe may be ſufficient: in a temperate Bath, two houres. For the time of continuing the Bath, there can be no certaine time ſet downe, but it muſt be according as the patient findes amendment, ſometimes twenty dayes, ſometimes thirty, and in difficult caſes much longer. And therefore they reckon without their Hoſt, which aſſigne themſelues a certaine time, as perhaps their occaſions of buſineſſe will beſt afford. For the time of the yeere, our Italian and Spaniſh Authors preferre the Spring and Fall; and ſo they may well do in their hot Countries; but with vs conſidering our clymat is colder, and our Bathes are for cold diſeaſes; I hold the warmeſt months in the yeere to be beſt; as May, Iune, Iuly, and Auguſt; and I haue perſwaded many hereun-

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to who haue found the benefit of it; for both in our Springs, and after September our weather is commonly variable, and apt to offend weake persons; who finding it temperate at noone, doe not suspect the coolenesse of the mornings and euenings. Likewise in the Bath it selfe, although the Springs arise as hot as at other times, yet the winde and ayre beating vpon them, doth doe them much harme, and also make the surface of the water much cooler then the bottome: and therefore *Claudinus* wisheth all Bathes to be couered, and *Fallopius* findes great fault with the Lords of Venice, that they do not couer their Bath at Apono. Wee see also that most of the Bathes in Europe are couered, whereby they retaine the same temperature at all times. And it were to be wished that our Queenes Bath, and Crosse Bath, being small Bathes, were couered, and their Slips made close and warme. By this meanes our Bathes would be vsefull all the yeare, when neither winde and cold ayre in winter, nor the Sunne in Summer should hinder our bathing. Moreouer for want of this benefit, many who haue indifferently wel recouered in the Fall, doe fall backe againe in the winter before the Cure bee perfectly finished: and as this would be a great benefit to many weake persons, so it would be no harme to this City, if it may be a meanes of procuring more resort hither in the winter time, or more early in the spring, or more late at the Fall.

I desire not nouelties, or to bring in innouations, but I propound these things vpon good grounds and examples of the best Bathsin Europe, & so I desire to haue them considered of; referring both this point, and whatsoeuer else I haue said in this Discourse, to the censure of those who are able to iudge.

I doe purposely omit many things about the vertues

and vses of our Bathes, which belong properly to the Physitian, and cannot well be intimated to the patient without dangerous mistaking. For as *Galen* saith, our Art of Physick goes vpon two legges, Reason and Experience, and if either of these be defectiue, our Physick must needs be lame. Experience was first in order: *Per varios vsus artem experientia fecit, exemplo monstrante viam:* Reason followed, which without Experience, makes a mere contemplatiue and theoricall Physitian. Experience with out Reason, make a mere Empiririck, no better then a Nurse or an attendant vpon sick persons, who is not able out of all the experience he hath, to gather rules for the cure of others. Wherefore they must be both ioyned together: and therefore I referre Physitians works vnto Physitians themselues.

De compos. med. loc. l. 8. c. 7.

FINIS.