





*The Most Honourable John Marquis of
Tweeddale Earle of Gifford Viscount
Walden, Lord Hay of Yester &c.*

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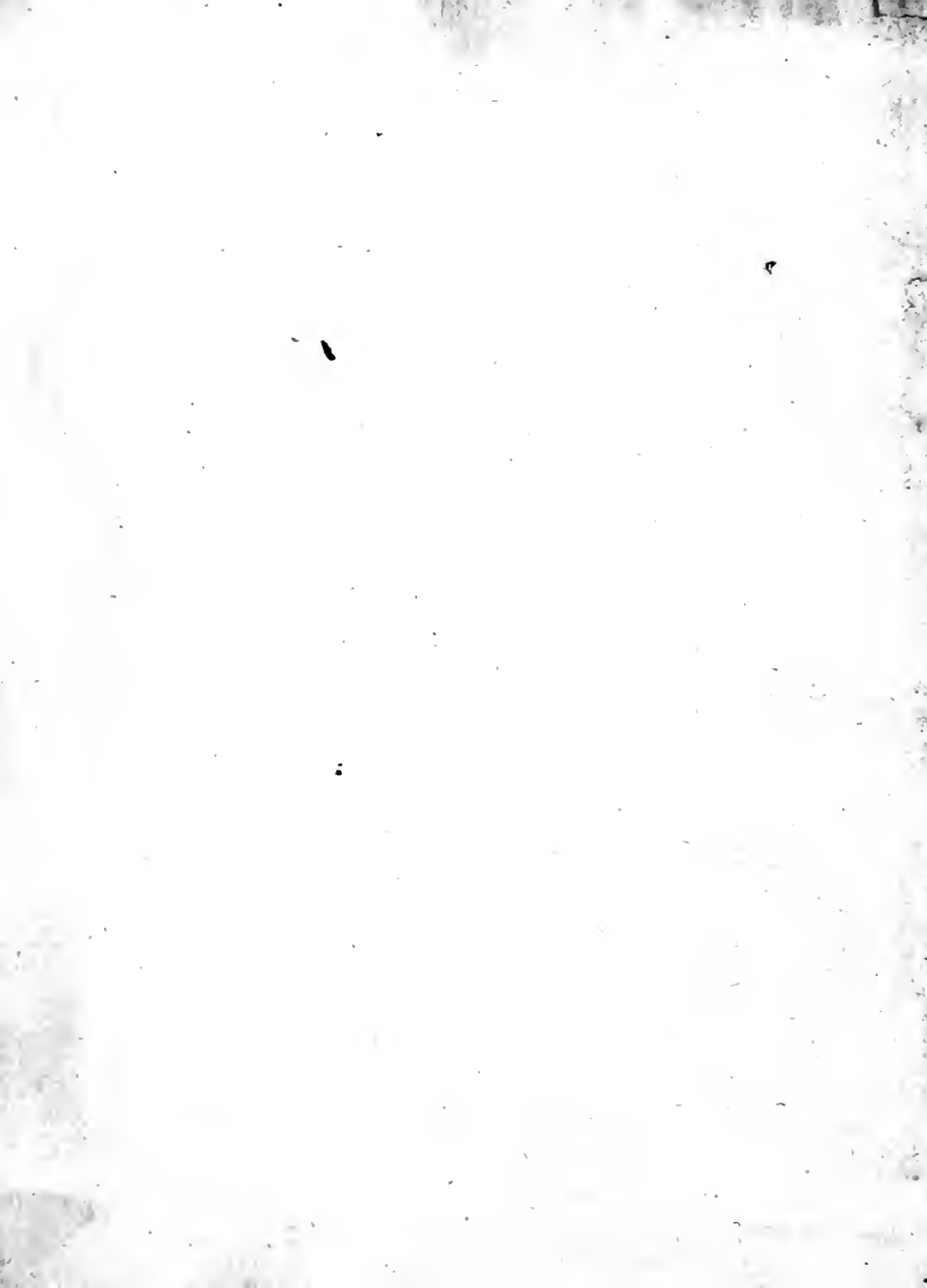
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TWO TREATISES:

In the one of which,
THE NATURE OF BODIES;

In the other,
THE NATURE OF MANS SOULE,
IS LOOKED INTO:

IN WAY OF DISCOVERY
OF THE
IMMORTALITY
OF
REASONABLE SOULES.

Ψυχῆς φύσιν ἀξίως λόγου
Κατανοῆσαι οἷός τι δυνατὸν εἶναι,
Ἄνδ' ἢ τ' ὅλα φύσεως;

*Anima naturam, absque totius natura,
Sufficienter cognosci posse, existimas?*

Plato in Phœdr.

L O N D O N,
Printed for *John Williams*, and are to be sold at the
Crowne in *S. Pauls Church-yard*.

M D C X L V.

Printed for J. H. Williams, and sold by the
D. C. Williams
D. C. Williams



T O M Y S O N N E,
K E N E L M E D I G B Y.

S O N N E,



He calamity of this time being such, as hath bereft me of the ordinary means of expressing my affection to you; I have been casting about, to finde some other way of doing that in such sort, as you may receive most profit by it. Therein I soone pitched upon these considerations; That Parents owe unto their children, not onely materiall subsistence for their Body, but much more, spirituall contributions to their better part, their Mind. I am much bound to God, that he hath endued you with one, very capable of the best instructions: and withall, I doe therefore esteeme my selfe obliged, to doe my utmost for moulding

it to its most advantage. If my ayme therein doe prove successfull, you will with more ease digest those inconveniences & distresses, which already you have begun to be acquainted with, and that threaten daily worse unto you. For how can a man suffer his heart to be dejected at the privation of any temporall blessings, whiles he considereth the inanity of them; and that nothing is worthy his serious thought, but what may accompany him to his eternall habitation? What needeth he feare the desolations of Warre, and the worst that they can do against him, who have his estate in their power, when he may be rich with a much nobler treasure, that none but himselfe can rob him of? Without doubt, he that shall seriously reflect upon the excellency of his owne nature, and upon the admirable perfect and happy state he shal most certainly arrive unto, if he but weane himselfe from those worldly impediments, that here clog his soules flight; cannot choose but look with a disdainfull eye, upon the glittering trifles, that weak spirits delight themselves withall. If he deeme it not requisite (as of old, the famous wise man did) to throw away those

encumbrances, to the end he may the more freely attend unto divine contemplations (for worldly goods, duly used, may be very advantageous both to ones selfe and to others) yet at the least, he will not repine at Fortunes recalling of what she formerly had but lent him, and but permitted him the use of.

To the end then that you may be armed against the worst that may arrive unto you, in this unhappy state of affaires, in our distressed Country; I send you those considerations of the nature and Immortality of humane soules, which of late, have been my chiefe entertainment. The progresse you have already made in the study of Phylosophie, hath (I am perswaded) enabled you to benefit your selfe, with what I have written upon this subject: on the serious examining of which, if you will employ but half the time, that I have done in spinning out my thoughts, and weaving them into the piece you see, I doubt not but you will thereby receive so much contentment, as well as profit, that you will not repent you of your paines. Besides that, intellectuall entertainments are the purest, and the noblest, and the most proporti-

onate to mans nature, and prove the most delightfull to him, when they are duly relished. You will presently agree, that the matter I handle, is the most important and the most weighty, within the whole extent of humane nature, for a worthy person to employ himselfe about. The advantage which Man hath over unreasonable creatures, is, that what he doth, is by election ; and he is himselfe master of all his actions ; whereas they are impelled by outward causes, unto all they doe : it is properly said of them, that *aguntur magis quam agunt* : He onely is free ; and in all varieties of circumstances, hath the power to choose one, and to reject another. Now, to have this election wisely made, and becomming a man, requireth that it be steered by knowledge. To doe any thing well, a man must first know throughly all that concerneth the action he is about ; and chiefly the end of it. And certainly, of all his actions, the government of himselfe, is the most important, and neerliest concerning him. The end of that government, and of all a mans aymes, is by all men agreed to be Beatitude : that is, his being completely well, and in a condition of enjoying the
most

most happinesse, that his nature is capable of. For arrivall whereunto, it is impolsible to pitch upon the direct and sure meanes, unlesse it be first determined, whether the Beatitude we speak of, doe belong to this life, or be not to be attained, till we come to the next: or rather, whether or no, there be another life besides this, to be happy in. For if there remaineth an eternity unto us, after the short revolution of time we so swiftly run over here on earth; it is cleare, that all the happines which can be imagined in this fleeting state, is not valuable, in respect of the future; nor any thing we doe here is considerable, otherwise then as it conduceth to the making our condition then, better or worse. Now the way to be sure of this, is either infallible authority, or evident science. They that rely on the first, depend of others: and they onely who know, are absolutely complete of themselves; and have within themselves, the principles whereby to govern their actions, in what is of highest consequence to them. It is true, every body is not of a straine of wit and judgement, to be of this rank: and who are not, must be contented to beleve others, and be

satisfyed with what is taught them. But he that will be of a superior orbe, must make this his study. This is the adequate entertainment of a worthy person.

To conceive how high and excellent, this science of governing a man in order to Beatitude in the next world is, we may consider, how among all arts that concern this life, the art of a Statesman, unto whom belongeth to see a Common-wealth well governed, is by much the noblest. All other arts, are but ministerially to him. He maketh use of the Soldier, of the Lawyer, of the Orator, of the Antiquary, of the Physitian, as best conduceth to the end he aymeth at, of making the Commonwealth he governeth, happy and flourishing. All other meaner Trades serve him in a yet lower degree. Yet after all, he must take his measures from the Metaphysitian or Divine. For since the government of a society of men, aymeth at giving them the best being they are capable of; and since Mans well-being here in this life, is but instrumentally good, as being the meanes for him to be well in the next life; It is evident, that the States-mans art, is but instrumentall to that, which

which sheweth, how every particular man must governe his life, to be partaker of a happy eternity. And consequently, if a Statesman hath not this science, he must be subject to a braver man then himselfe, whose province is to direct all his actions unto this end. We are told, how reverently great *Cesar* listened to the discourses of learned *Achoreus*, how observant *Alexander* was of his Master *Aristotle*, how secure *Nero* trode, whiles *Seneca* guided his steps, how humble *Constantine* was to Saint *Sylvesters* precepts, how *Charlemaine* governed himselfe in his most important actions, by *Alcaines* advice: In a word, all the great men of Antiquity, as wel among the Romans, as among the Gretians, had their Philosophers, and Divines in their kind, belonging to them; from whom they might derive rules of living and doing as they ought upon all occasions, if themselves were not Masters in that superiour and all-directing science. He that seeth not by his owne light, must in this dangerous Ocean steere by the lanterne which another hangeth out to him. If the person he relyeth upon, either withholdeth the light from him, or sheweth him a false one, he is presently in the dark,

darke, and cannot faile of losing his way. How great an authority had the Augurs and Priests among the rude Romans, to forbid any public act, or to break any assembly upon pretence of Religious duties; when they liked not the businesse that was in agitation? The like may interessed Divines among Christians doe, if the Ministers of State have not some insight into Divinity. He leadeth a vexatious life, that in his noblest actions is fogored with scruples, that he dareth not make a step, without the authority of another to warrant him.

Yet I doe not conclude, that he by whom I design by the character of a brave man, should be a professed or a complete Metaphysitian or Divine, and consummate in every curious circumstance that belongeth to this science; it sufficeth him to know it in bulke; and to have so much Divinity, as in common occurrents, to be able to governe himselfe, and in speciall ones, to understand what, and why his Divine perswadeth him to any thing; so that even then, though not without help, yet he governeth himselfe, and is not blindly governed by another. He that aymeth at being a perfect
Horse-

Horseman, is bound to know in generall (besides the art of riding) the nature and temper of Horses; and to understand the different qualities of Bits, Saddles, and other utensils of a Horseman; But the utmost exactnesse in these particulars, belongeth to Farryers, Saddlers, Smiths, and other Tradesmen; of all which, the judicious Rider knoweth how to make due use, when he hath occasion, for his principall end; which is, orderly governing his Horse. In like manner, he whom we designe by a complete brave man, must know solidly the maine end of what hee is in the World for: and withall, must know how to serve himselfe when hee pleaseth; and that it is needfull to him, of the Divines high Contemplations, of the Metaphysitians subtile Speculations, of the naturall Philosophers minute Observations; of the Mathematicians nice Demonstrations; and of whatsoever else of particular Professions, may conduce to his end; though without making any of them his professed businesse.

To lay grounds for such knowledge as this, is the scope of my ensuing Discourse. My first ayme, was to beget it in my selfe: to
which

which end, the digesting my thoughts into order, and the setting them downe in writing, was necessary: for without such strict examination of them, as the penning them affordeth one meanes to make, they would hardly have avoyded being disjoynted and roving ones. Now that I have done that, my next ayme is that you, unto whom I wish as much good as unto my selfe, may reap as much benefit by the studying it, as I have done by the composing it.

My end then being a private one, as (looking no further then you my sonne, and my selfe) I have not endeavoured to expresse my conceptions either in the phrase, or in the language of the Schooles. It will serve our turne, to comprehend the substance, without confining our selves to any scrupulous exactnesse, in what concerneth onely forme. And the same consideration hath made me passe slightly over many particulars, in my first Treatise of the Nature of Bodies; upon which learned and witty men might spin out large Volumes. For in that patt, I ayme no further, then to shew what may be effected by corporeall agents. There, possibility serveth
my

my turne, as well as the determinate indivisible point of truth. I am obliged to that, onely in my maine great theme; which is the soule. In regard of which, the numerous crooked narrow cranies, and the restrayned flexuous rivolets of corporeall things, are all contemptible, further then the knowledge of them serveth to the knowledge of the soule. And a gallant man, whose thoughts flye at the highest game, requireth no further insight into them, then to satisfie himselfe by what way they may be performed; and deemeth it far too meane for him, to dwel upon the subtilest of their mysteries for science sake.

Besides this liberty that the scope I ayme at alloweth me of passing very cursorily over sundry particulars; I find now at my reading all over together, what I have written to deliver it to the Printer, that even in that which I ought to have done to comply with my owne designe and expectation, I am fallen very short; so that if I had not unwarily too farre engaged my selfe for the present publishing it, truly I should have kept it by me, till I had once againe gone over it. I find the whole piece very confusedly done;
the

the stile unequall and unpolished ; many particulars (when they are not absolutely necessary to my maine drift) too slightly touched, and far from being driven home : and in a word, all of it seemeth to be rather but a loose modell and roughcast of what I design to do, then a complete work throughly finished.

But since by my overforward promising of this piece to severall friends, that have been very earnest for it, I have now brought my self to that passe, that it would ill become me to delay any longer the publishing of something upon this subject and that obligations of another nature permit me not at the present to dwell any longer upon this (besides that, so lazie a braine as mine is, groweth soon weary when it hath so entangled a skeane as this is to unwind) I now send it you as it is; but with a promise, that at my first leisure, I will take a strict survey of it ; and then in another Edition, will polish, correct and adde what shall appeare needfull to me. If any man shall take the Book out of your hand, invited by the Title and subject to look into it; I pray you in my behalfe represent unto him , how distant my profession is, and how contrary my education hath

hath been from writing of Books. In every Art, the plainest that is, there is an Apprenti-ship necessary, before it can be expected one should work in it a fashionable piece. The first attempts are alwayes very imperfect aydings; and are scarce discernable what they are meant for, unlesse the Master guide his Scholars hand. Much more will the same happen in so difficult and spiny an affaire, as the writing upon such a nice and copious subject as this is, to one who is so wholly ignorant of the lawes of Method as I am.

This free and ingenuous acknowledgment on my side, will I hope prevaile with all ingenuous persons, who shall read what I have written, to advertise me fairely (if they judge it worth their while) of what they dislike in it: to the end that in another more accurate Edition, I may give them better satisfaction. For besides what saylings may be in the matter, I cannot doubt but that even in the expressions of it, there must often be great obscurity and shortnesse; which I, who have my thoughts filled with the things themselves, am not aware of. So that, what peradventure may seeme very full to me, because every imperfect touch

touch bringeth into my mind the entire notion and whole chain of circumstances belonging to that thing I have so often beaten upon; may appeare very crude and maymed to a stranger, that cannot guesse what I would be at, otherwise then as my direct words do lead him.

One thing more I shall wish you to desire of them who happily may peruse these two Treatises; as well for their owne sakes, as for mine. And that is, that they wil not passe their censure upon any particular piece, or broken parcell of eyther of them, taken by it selfe. Let them draw the entire thred through their fingers, and let them examine the consequentness of the whole body of the doctrine I deliver; and let them compare it by a like survey with what is ordinarily taught in the Schools: and if they find in theirs, many bracks and short ends which cannot be spun into an even piece, and in mine, a faire coherence throughout; I shall promise my selfe a favourable doome from them, and that they will have an acquiescence in themselves to what I have here presented them with: whereas, if they but ravell it over loosely, & pitch upon disputing

ting against particular conclusions, that at the first encounter of them single, may seem harsh unto them, (which is the ordinary course of flashy wits, who cannot fadome the whole extent of a large discourse) it is impossible but that they should be very much unsatisfyed of me; and goe away with a perswasion, that some such truths as upon the whole matter are most evident (one stone in the arch supporting another, and the whole) are meere chymeras and wild paradoxes.

But (Sonne) it is time my Booke should speake it selte, rather then I speak any longer of it here. Read it carefully over, and let me see by the effects of your governing your self, that you make such right use of it, as I may be comforted in having chosen you to bequeath it unto. God in heaven blesse you. *Paris* the last of *August*, 1644.

Your Loving Father,

KENELME DIGBY.



THE PREFACE.

THis writing was designed to have seen the light under the name of one Treatise. But after it was drawn in paper; as I cast a view over it, I found the Proæmiall part (which is that which treateth of Bodies) so ample in respect of the other (which was the end of it; and for whose sake I medled with it) that I readily apprehended my Reader would think I had gone much astray from my Text, when proposing to speak of the Immortality of Mans Soule, three parts of foure of the whole Discourse, should not so much as in one word mention that soule, whose nature and proprieties I aymed at the discovery of. To avoid this incongruity, occasioned me to change the name and unity of the work; and to make the survey of bodies, a body by it selfe: though subordinate to the Treatise of the Soule. Which notwithstanding it be lesse in bulke then the other, yet I dare promise my Reader, that if he bestow the paines requisite to perfect himselfe in it, he will find as much time well spent in the due reading of it, as in the reading of the former Treatise, though far more large.

But I discern an Objection obvious to be made, or rather a Question; Why I should spend so much time in the consideration of Bodies, whereas none that hath formerly written of this subject, hath in any measure done the like?

I might answer that they had, upon other occasions, first written of the nature of Bodies: as I may instance in Aristotle;

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Aristotle; and sundry others, who either have themselves professedly treated the Science of Bodies, or have supposed that part sufficiently performed by other pens. But truly, I was by an unavoidable necessity hereunto obliged: which is, a current of doctrine that at this day, much raigneth in the Christian Schooles, where bodies and their operations, are explicated after the manner of spirituall things. For we having very slender knowledge of spirituall substances, can reach no further into their nature, then to know that they have certaine powers, or qualities; but can seldome penetrate so deep, as to descend to the particulars of such Qualities, or Powers. Now our modern Philosophers have introduced such a course of learning into the Schooles, that unto all questions concerning the proper natures of Bodies, and their operations, it is held sufficient to answer, they have a quality, or a power to doe such a thing. And afterwards they dispute whether this Quality or Power, be an Entity distinct from its subject, or no; and how it is separable, or unseparable from it, and the like. Conformable to this, who will looke into the books, which are in vogue in these Schooles, shall find such answers and such controversies every where, and few others. As, of the sensible qualities: aske what it is to be white or red, what to be sweet or sowre, what to be odoriferous or stinking, what to be cold or hot? And you are presently paid with, that it is a sensible quality, which hath the power to make a wall white or red, to make a meat agreeable or disagreeable to the taste, to make a gratefull or ungratefull smell to the nose, &c. Likewise they make the same questions and resolutions, of Gravity and Levity: as whether they be qualities, that is, entities distinct from their subject: and whether they be active or passive; which when they have disputed slightly, and in common, with Logickall arguments, they rest there, without any further searching into the physickall causes or effects of them. The like you shall find of all strange effects

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of them. The Load-stone and Electricall bodies are produced for miraculous, and not understandable things; and in which, it must be acknowledged, that they work by hidden qualities, that mans wit cannot reach unto. And ascending to living bodies, they give it for a Maxime: that life is the action of the same Entity upon it selfe: that sense is likewise a worke of an intrinsecall power, in the part we call Sense, upon it selfe. Which, our predecessors held the greatest absurdities that could be spoken in Phylosophie. Even some Physitians, that take upon them to teach the curing of our bodies, doe often pay us with such termes; among them, you have long discourses of a retentive, of an expulsive, of a purging, of a consolidating faculty: and so of every thing that either passeth in our body, or is applyed for remedy. And the meaner sort of Physitians know no more, but that such faculties are; though indeed they that are truly Physitians, know also in what they consist; without which knowledge it is much to be feared, Physitians will doe more harme then good.

But to returne to our subject: this course of doctrine in the Schools, hath forced me to a great deale of paines in seeking to discover the nature of all such actions (or of the maine part of them) as were famed for incomprehensible: for what hope could I have, out of the actions of the soule to convince the nature of it to be incorporeall; if I could give no other account of bodies operations, then that they were performed by qualities occult, specificall, or incomprehensible? Would not my adversary presently answer, that any operation, out of which I should presse the soules being spirittuall, was performed by a corporeall occult quality: and that as he must acknowledge it to be incomprehensible, so must I likewise acknowledge other qualities of bodies, to be as incomprehensible: & therefore could not with reason presse him, to shew how a body was able to doe such an operation: as I should inferre must of necessity proceed from

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from a spirit, since that neither could I give account how the loadstone drew iron, or looked to the North; how a stone, and other heavy things were carried downwards; how sight or fantasie was made; how digestion or purging were effected; and many other such questions, which are so slightly resolved in the Schooles?

Besides this reason, the very desire of knowledge in my self; and a willingnesse to be available unto others (at the least so farre as to set them on seeking for it, without having a prejudice of impossibility in attaining it) was unto me a sufficient motive, to enlarge my discourse to the bulk it is risen unto. For what a misery is it, that the flower and best wits of Christendome, which flock to the Vniuersities, under pretence and upon hope of gaining knowledge, should be there deluded; and after many yeares of toyle and expence, bee sent home againe, with nothing acquired more then a faculty, and readinesse to talke like Parrats of many things; but not to understand so much as any one; and withall with a perswasion that in truth nothing can be knowne? For setting knowledge aside, what can it auaille a man to be able to talke of any thing? What are those wranglings, where the discovery of truth is neither sought, nor hoped for, but meerly vanity and ostentation? Doth not all tend, to make him seem and appeare that which indeed he is not? Nor let any body take it ill at my hands, that I speak thus of the moderne Schooles: for indeed it is rather themselves then I that say it. Excepting Mathematicks, let all the other Schooles pronounse their owne minds, and say ingeniously, whether they themselves beleeeve they have so much as any one demonstration, from the beginning to the ending of the whole course of their learning. And if all, or the most part, will agree that any one position is demonstrated perfectly, and as it ought to bee, and as thousands of conclusions are demonstrated in Mathematickes; I am ready to undergoe

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the blame of having calumniated them, and will as readily make them amends. But if they neither will, nor can; then their owne verdict cleareth me: and it is not so much I, as they, that make this profession of the shallownesse of their doctrine. And to this purpose I have often heard the lamentations of divers, as great wits as any that converse in the Schooles, complaining of this defect. But in so great an evidence of the effect, proofes are superfluous.

Wherefore I will leave this subject, to declare what I have here designed, and gone about, towards the remedy of this inconvenience. Which is, that whereas in the Schooles, there is a loose method, or rather none; but that it is lawfull, by the liberty of a Commentator, to handle any question, in any place (which is the cause of the slightnesse of their doctrine, and can never be the way to any science or certitude) I have taken my beginnings from the commonest things that are in nature: namely, from the notions of Quantity, and its first differences: which are the most simple, and radicall notions that are, and in which all the rest are to be grounded. From them I endeavour by immediate composition of them, and derivation from them, to bring downe my discourse to the Elements, which are the primary and most simple bodies in nature. From these, I proceed to compounded bodies; first, to those that are called mixed; and then, to living bodies: declaring in common the proprieties and operations that belong unto them. And by occasion as I passe along, I light here and there on those operations, which seem most admirable in nature, to shew how they are performed; or at the least, how they may be performed: that though I misse in particular of the industry of nature, yet I may neverthelesse hit my intent; which is, to trace out a way, how these, and such like operations may be effected by an exact disposition, and ordering (though intricate) of quantitative and corporeall parts: and to shew, that they oblige us not to

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recurre unto hidden and unexplicable qualities. And if I have declared so many of these, as may beget a probable persuasion in my reader, that the rest, which I have not touched, may likewise be displayed, and shewed to spring out of the same grounds, if curious and constant searchers into nature, will make their taske to penetrate into them; I have therein obtained my desire and intent; which is onely, to shew from what principles, all kinds of corporeall operations doe proceed, and what kind of operations all these must be, which may issue out of these principles: to the end, that I may from thence, make a step to raise my discourse to the contemplation of the soule; and shew, that her operations are such, as cannot proceed from those principles; which being adequate and common to all bodies, we may rest assured, that what cannot issue from them, cannot have a body for its source.

I will therefore end this preface, with entreating my Reader to consider, that in a discourse proceeding in such order as I have declared, he must not expect to understand, and be satisfied, with what is said in any middle or latter part, unlesse he first have read, and understood what goeth before. Wherefore, if he cannot resolve with himselfe, to take it along orderly as it lyeth from the beginning, he shall doe himselfe (as well as me) right, not to meddle at all with this booke. But if hee will employ any time upon it, to receive advantage by it, he must be content to take the paines to understand thoroughly every particular as it is set downe. And if his memory will not serve him to carry every one along with him, yet at the least, let him be sure to remember the place where it is handled, and upon occasion, return a look back upon it, when it may stand him in stead. If he thinketh this diligence too burthensome, let him consider that the writing hereof hath cost the Authour much more pains: who as he will esteem them exceedingly well employed, if they may contribute ought to the content or advantage

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tage of any free and ingenuous mind; so if any others shall expresse a neglect of what he hath with so much labour hewed out of the hard rock of Nature; or shall discourteously cavill at the notions he so freely imparteth unto them; all the resentment he shall make thereof, will be to desire the first, to consider, that their slight esteeme of his worke, obligeth them to entertaine their thoughts with some more noble and more profitable subject, and better treated, then this is: and the latter sort, to justifie their dislike of his doctrine, by delivering a fairer and more complete body of Philosophy, of their owne. Which if hereupon they doe, his being the occasion of the ones bettering themselves, and of the others bettering the world, will be the best successe he can wish his Booke.

A Table shewing what is contained in the severall Chapters and Sections in this *Treatise* concerning BODIES.

The figures after the Chapters, are the Sections belonging to every Chapter: which Sections the Reader shall find in every Chapter by their figures in the margine.

CHAP. I.

THe Preface. A Preamble to the whole discourse; concerning notions in generall.

1. *Quantity is the first, and most obvious affection of a body.*
2. *Words do not expresse things as they are in themselves, but onely as they are painted in the minds of men.*
3. *The first error that may arise from hence; which is a multiplying of things, where no such multiplication is really found.*
4. *A second error; the conceiving of many distinct things as really one thing.*
5. *Great care to be taken to avoid the errors which may arise from our manner of understanding things.*
6. *Two sorts of words to expresse our notions, the one common to all men, the other proper to schollers.*
7. *Great errors arise by wresting words from their common mean.*

ing to expresse a more particular or studied notion.

CHAP. II.

Of Quantity.

1. *We must know the vulgar and common notion of Quantity that we may understand the nature of it.*
2. *Extension or divisibilitie is the common notion of Quantity.*
3. *Parts of Quantity are not actually in their whole.*
4. *If parts were actually in their whole, Quantity would be composed of indivisibles.*
5. *Quantity cannot be composed of indivisibles.*
6. *An objection to prove that parts are actually in Quantitie; with a declaration of the mistake from whence it proceedeth.*
7. *The solution of the former objection: vnd that sense cannot discern whether one part be distinguished from another, or no.*
8. *An enumeration of the severall*
*
speciese

specieses of Quantity, which confirmeth that the essence of it is divisibilitie.

CHAP. III.

Of Rarity and Density.

1. *What is meant by Rarity and Density.*
2. *It is evident that some bodies are rare and others dense; though obscure, how they are such.*
3. *A brief enumeration of the severall properties belonging to rare and dense bodies.*
4. *The opinion of those Philosophers declared, who put rarity to consist in an actual division of a body into little parts.*
5. *The former opinion rejected, and the ground of their error discovered.*
6. *The opinion of those Philosophers related, who put rarity to consist in the mixtion of vacuity among bodies.*
7. *The opinion of vacuities refuted.*
8. *Rarity and Density consist in the severall proportions which Quantity hath to its substance.*
9. *All must admit in Physicall bodies, a Metaphysicall composition.*

CHAP. IV.

Of the foure first qualities: and of the foure Elements.

1. *The notions of density and rarity have a latitude capable of infinite variety.*
2. *How moistnesse and drinesse are begotten in dense bodies.*
3. *How moistnesse and drynesse are begotten in rare bodies.*
4. *Heat is a property of rare bodies, and cold of dense ones.*
5. *Of the two dense bodies, the lesse dense is more cold: but of the two rare ones, the lesse rare is lesse hot.*
6. *The extreme dense body is more drie, then the extreme rare one.*
7. *There are but foure simple bodies: and these are rightly named Elements.*
8. *The Authour doth not determine whether every element doth comprehend under its name one onely lowest species, or many: nor whether any of them be found pure.*

CHAP. V.

Of the operations of the Elements in generall. And of their Activities compared with one another.

1. *The first operation of the Elements is division, out of which results*

A Table.

- resulteth locall motion.
2. *What place is both notionally, and really.*
 3. *Locall motion is that division, whereby a body changeth its place.*
 4. *The nature of quantity of it self is sufficient to unite a body to its place.*
 5. *All operations amongst bodies are either locall motion, or such as follow out of locall motion.*
 6. *Earth compared to water in activity.*
 7. *The manner whereby fire getteth into fewell, proveth that it exceedeth earth in activity.*
 8. *The same is proved by the manner, whereby fire cometh out of fewell and worketh upon other bodies.*

CHAP. VI.

Of Light, what it is.

1. *In what sense the Author rejecteth qualities.*
2. *In what sense the Author doth admit of qualities.*
3. *Five arguments proposed to prove that light is not a body.*
4. *The two first reasons to prove light to be a body are, the resemblance it hath with fire; and because if it were a quality, it would alwayes produce an equal to it self.*

5. *The third reason, because if we imagine to our selves the substance of fire to be rarified, it will have the same appearances which light hath.*
6. *The fourth reason, from the manner of the generation and corruption of light, which agreeth with fire.*
7. *The fifth reason, because such properties belong to light as agree onely unto bodies.*

CHAP. VII.

Two objections answered against light being fire, a more ample prooffe of its being such.

1. *That all light is hot and apt to heat.*
2. *The reason why our bodies for the most part do not feel the heat of pure light.*
3. *The experience of burning glasses, and of soultry gloomy weather, prove light to be fire.*
4. *Philosophers ought not to judge of things by the rules of vulgar people.*
5. *The different names of lights and fire, proceed from different notions of the same substance.*
6. *The reason why many times fire and heat are deprived of light.*
7. *What becometh of the body of light when it dieth.*

A Table.

8. *An experiment of some who pretend, that light may be precipitated into powder.*
9. *The Authors opinion concerning lamps, pretended to have been found in tombes, with in-consumptible lights.*

CHAP. VIII.

An answer to three other objections formerly proposed, against light being a substance.

1. *Light is not really in every part of the room it enlightneth, nor filleth entirely any sensible part of it, though it seem to us to do so.*
2. *The least sensible point of a diaphanous body, hath room sufficient to contain both aire and light, together with a multitude of beams, issuing from severall lights without penetrating one another.*
3. *That light doth not enlighten any room in an instant, and that the great celerity of its motion doth make it imperceptible to our senses.*
4. *The reason why the motion of light, is not discerned coming towards us, and that there is some reall tardity in it.*
5. *The planets are not certainly ever in that place where they appear to be.*
6. *The reason why light being a body, doth not by its motion*

- shatter other bodies into pieces.*
7. *The reason why the body of light is never perceived to be fanned by the wind.*
8. *The reasons for, and against lights being a body, compared together.*
9. *A summary repetition of the reasons which prove that light is fire.*

CHAP. IX.

Of locall motion in common.

1. *No locall motion can be performed without succession.*
2. *Time is the common measure of all succession.*
3. *What velocity is, and that it cannot be infinite.*
4. *No force so little, that is not able to move the greatest weight imaginable.*
5. *The chief principle of Mechanics, deduced out of the former discourse.*
6. *No moveable can passe from rest to any determinate degree of velocity, or from a lesser degree to a greater, without passing through all the intermediate degrees which are below the obtained degree.*
7. *The conditions which help to motion, in the moveable are three; in the medium, one.*
8. *No body hath any intrinsecall virtue to move it self towards any determinate part of the universe.*
9. *The*

A Table.

9. *The encrease of motion is alwayes made in the proportion of the odde numbers.*
10. *No motion can encrease for ever, without coming to a period.*
11. *Certain problemes resolved concerning the proportion of some moving Agents compared to their effects.*
12. *When a moveable cometh to rest, the motion doth decrease according to the rules of encrease.*

CHAP. X.

Of Gravity and Levity; and of local Motion, commonly termed Naturall.

1. *Those motions are called naturall, which have constant causes; and those violent, which are contrary to them.*
2. *The first and most generall operation of the sunne, is the making and raising of atomes.*
3. *The light rebounding from the earth with atomes, causeth two streams in the aire; the one ascending, the other descending; and both of them in a perpendicular line.*
4. *A dense body placed in the aire between the ascending and descending stream, must needs descend.*
5. *A more particular explication*

- of all the former doctrine touching gravity.*
6. *Gravity and levity do not signifie an intrinsecall inclination to such a motion in the bodies themselves which are termed heavy and light.*
 7. *The more dense a body is, the more swiftly it descendeth.*
 8. *The velocity of bodies descending doth not encrease in proportion to the difference that may be between their severall densities.*
 9. *More or lesse gravity doth produce a swifter or a slower descending of a heavy body. Aristotles argument to disprove motion in vacuo, is made good.*
 10. *The reason why at the inferior quarter of a circle, a body doth descend faster by the arch of that quarter, then by the cord of it.*

CHAP. XI.

An answer to objections against the causes of naturall motion, avowed in the former chapter; and a refutation of the contrary opinion.

1. *The first objection answered; why a hollow body descendeth slower then a solid one.*
2. *The second objection answered and the reasons shown, why atomes do continually overtake*

A Table.

- the descending dense body.
3. *A curious question left undecided.*
 4. *The fourth objection answered, why the descent of the same heavy bodies, is equall in so great inequality of the atomes which cause it.*
 5. *The reason why the shelter of a thick body doth not hinder the descent of that which is under it.*
 6. *The reason why some bodies sink, others swimme.*
 7. *The fifth objection answered concerning the descending of heavy bodies in streams.*
 8. *The sixth objection answered; and that all heavy elements do weigh in their owne spheres.*
 9. *The seventh objection answered, and the reason why we do not feel the course of the aire, and atomes that beat continually upon us.*
 10. *How in the same body, gravity may be greater then density, and density then gravity; though they be the same thing.*
 11. *The opinion of gravities being an intrinsecall inclination of a body to the center, refuted by reason.*
 12. *The same opinion refuted by severall experiences.*

CHAP. XII.

Of violent Motion.

1. *The state of the question touching the cause of violent motion.*
2. *That the medium is the onely cause, which continueth violent motion.*
3. *A further explication of the former doctrine.*
4. *That the aire hath strength enough to continue violent motion in a moveable.*
5. *An answer to the first objection; that aire is not apt to conserve motion; and how violent motion cometh to cease.*
6. *An answer to the second objection, that the aire hath no power over heavy bodies.*
7. *An answer to the third objection, that an arrow should fly faster broad wayes then long wayes.*

CHAP. XIII.

Of three sorts of violent motion, Reflexion, Undulation, and Refraction.

1. *That reflexion is a kind of violent motion.*
2. *Reflection is made at equall angles.*
3. *The causes and properties of undulation.*

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| <p>4. Refraction at the entrance into the reflectent body is towards the perpendicular; at the going out, it is from it; when the second superficies is parallel to the first.</p> <p>5. A refutation of Monsieur des Cartes his explication of refraction.</p> <p>6. An answer to the arguments brought in favour of Monsieur des Cartes his opinion.</p> <p>7. The true cause of refraction of light both at its entrance, and at its going out from the reflecting body.</p> <p>8. A generall rule to know the nature of reflection and refractions in all sorts of surfaces.</p> <p>9. A body of greater parts and greater pores, maketh a greater refraction then one of lesser parts and lesser pores.</p> <p>10. A confirmation of the former doctrine, out of the nature of bodies that refract light.</p> | <p>is in bodies of least cise; and it is made by the force of Quantity.</p> <p>4. The second sort of conjunction, is compactednesse in simple Elements, and it proceedeth from densitie.</p> <p>5. The third conjunction is of parts of different Elements, and it proceedeth from quantity and density together.</p> <p>6. The reason why liquid bodies do easily joyn together; and dry ones difficultly.</p> <p>7. That no two hard bodies can touch one another immediately.</p> <p>8. How mixed bodies are framed in generall.</p> <p>9. The cause of the severall degrees of solidity in mixed bodies.</p> <p>10. The rule whereunto are reduced all the severall combinations of Elements in compounding of mixed bodies.</p> <p>11. Earth and water are the basis of all permanent mixed bodies.</p> <p>12. What kind of bodies those are where water is the basis, and earth the predominant Element over the other two.</p> <p>13. Of those bodies, where water being the basis aire is the predominant Element.</p> <p>14. What kind of bodies result, where water is the basis, and fire the predominant Element.</p> <p>15. Of those bodies, where water</p> |
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CHAP. XIV.

Of the composition, qualities, and generation of mixed bodies.

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| <p>1. The connexion of this chapter with the rest, and the Authors intent in it.</p> <p>2. That there is a least cise of bodies; and that this least cise is found in fire.</p> <p>3. The first conjunction of parts</p> | <p>15. Of those bodies, where water</p> |
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- is in excesse, it alone being both the basis, and the predominant Element.*
16. *Of those bodies, where earth alone is the basis, and also the predominant in excesse over the other three Elements.*
 17. *Of those bodies where earth is the basis, & water the predominant element over the other two*
 18. *Of those bodies, where earth being the basis aire is the predominant.*
 19. *Of those bodies, where earth being the basis, fire is the predominant.*
 20. *All the second qualities of mixed bodies, arise from severall combinations of the first qualities; and are at last resolved into severall degrees of rarity and density.*
 21. *That in the planets and starres there is a like variety of mixed bodies caused by light as here upon earth.*
 22. *In what manner the Elements do work upon one another, in the composition of mixed bodies: and in particular fire which is the most active.*
 23. *A particular declaration touching the generation of metals.*
- and others tough, are apt to withstand outward violence the first instrument to dissolve mixed bodies.*
2. *How outward violence doth work upon the most compacted bodies.*
 3. *The severall effects of fire, the second and chiefeft instrument to dissolve all compounded bodies*
 4. *The reason why some bodies are not dissolved by fire.*
 5. *The reason why fire melteth gold, but cannot consume it.*
 6. *Why lead is easily consumed and calcined by fire.*
 7. *Why and how some bodies are divided by fire into spirits, waters, oyls, salts and earth. And what those parts are.*
 8. *How water the third instrument to dissolve bodies, dissolveth calx into salt; and so into terra damnata.*
 9. *How water mingled with salt, becometh a most powerfull Agent to dissolve other bodies.*
 10. *How putrefaction is caused.*

CHAP. XVI.

An explication of certain Maxims touching the operations, and qualities of bodies: and whether the Elements be found pure in any part of the world.

1. *What is the sphere of activity in corporeall agents.*

2. *The*

CHAP. XV.

Of the dissolution of mixed bodies.

1. *Why some bodies are brittle,*

A Table.

2. *The reason why no body can work in distance.*
3. *An objection answered against the manner of explicating the former axiome.*
4. *Of reaction: and first in pure locall motion, that each Agent must suffer in acting and act in suffering.*
5. *The former doctrine applyed to other locall motions designed by particular names. And that Swisseths argument is of no force against this way of doctrine.*
6. *Why some notions do admit of intension and remission; and others do not.*
7. *That in every part of our habitable world; all the foure elements, are found pure in small atomes; but not in any great bulk.*
6. *That yce is not water rarified but condensed.*
7. *How wind, snow, and hail are made; and wind by rain allaid.*
8. *How parts of the same or divers bodies, are joynd more strongly together by condensation.*
9. *Vacuities cannot be the reason, why water impregnated to the full with one kind of salt, will notwithstanding receive more of another.*
10. *The true reason of the former effect.*
11. *The reason why bodies of the same nature do joyne more easily together then others.*

CHAP. XVII.

Of rarefaction and condensation the two first motions of particular bodies.

1. *The Authours intent in this and the following chapters.*
2. *That bodies may be rarified, both by outward heat; and how this is performed.*
3. *Of the great effects of Rarefaction.*
4. *The first manner of condensation by heat.*
5. *The second manner of condensation by cold.*

CHAP. XVIII.

Of another motion belonging to particular bodies, called Attraction; and of certain operations termed Magicall.

1. *What Attraction is, and from whence it proceedeth.*
2. *The true sense of the Maxime, that Nature abhorreth from vacuity.*
3. *The true reason of attraction.*
4. *Water may be brought by the force of attraction to what height soever.*
5. *The doctrine touching the attraction of water in syphons.*
6. *That the syphon doth not prove water to weigh in its own orb.*

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7. Concerning

7. Concerning attraction caused by fire.
8. Concerning attraction made by virtue of hot bodies, anulets, &c.
9. The naturall reason given for divers operations, esteemed by some to be magickall.

CHAP. XIX.

Of three other motions belonging to particular bodies, Filtration, Restitution, and Electricall attraction.

1. What is Filtration; and how it is effected.
2. What causeth the water in filtration to ascend.
3. Why the filter will not drop unlesse the labell hang lower then the water.
4. Of the motion of Restitution: and why some bodies stand bent, others not.
5. Why some bodies return onely in part to their naturall figure; others entirely.
6. Concerning the nature of those bodies which do shrink and stretch.
7. How great and wonderfull effects, proceed from small, plain, and simple principles.
8. Concerning Electricall attraction, and the causes of it.
9. Cabeus his opinion refuted concerning the cause of Electricall motions.

Of the Loadstones generation; and its particular motions.

1. The extreme heat of the sunne under the zodiack, draweth a stream of aire from each Pole into the torrid zone.
2. The atomes of these two streams coming together are apt to incorporate with one another.
3. By the meeting and mingling together of these streams at the Equator, divers rivolets of atomes of each Pole, are continued from one Pole to the other.
4. Of these atomes incorporated with some fit matter in the bowels of the earth, is made a stone.
5. This stone worketh by emanations, joyned with agreeing streams that meet them in the aire; and in fine it is a loadstone.
6. A methode for making experiences upon any subject.
7. The loadstones generation by atomes flowing from both Poles, is confirmed by experiments observed in the stone it self.
8. Experiments to prove that the loadstone worketh by emanations, meeting with agreeing streams.

CHAP. XXI.

Positions drawn out of the former doctrine, and confirmed by experimental proofs.

1. *The operations of the loadstone are wrought by bodies and not by qualities.*
2. *Objections against the former position answered.*
3. *The loadstone is imbued with his vertue from another body.*
4. *The vertue of the loadstone is a double, and not one simple vertue.*
5. *The vertue of the loadstone worketh more strongly in the Poles of it, then in any other part.*
6. *The loadstone sendeth forth its emanations spherically. Which are of two kinds: and each kind is strongest in that hemisphere, through whose polary parts they issue out.*
7. *Putting two loadstones within the sphere of one another, every part of one loadstone doth not agree with every part of the other loadstone.*
8. *Concerning the declination and other respects of a needle, towards the loadstone it toucheth*
9. *The vertue of the loadstone getteth from end to end in lines almost parallell to the axis.*
10. *The vertue of a loadstone is not perfectly sphericall though the stone be such.*

11. *The intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and the attracted bodies.*
12. *The main globe of the earth not a loadstone.*
13. *The loadstone is generated in all parts or climates of the earth*
14. *The conformity betwixt the two motions of magnetick things and of heavy things.*

CHAP. XXII.

A solution of certain Problemes concerning the loadstone, and a short summe of the whole doctrine touching it.

1. *Which is the North, and which the South Pole of a loadstone.*
2. *Whether any bodies besides magnetick ones be attractive.*
3. *Whether an iron placed perpendicularly towards the earth doth get a magnetical vertue of pointing towards the north, or towards the south in that end that lieth downwards.*
4. *Why loadstones affect iron better then one another.*
5. *Gilberts reason refuted touching a capped loadstone, that taketh up more iron then one not capped; and an iron impregnated that in some case draweth more strongly then the stone it self.*
6. *Galileus his opinion touching*

A Table.

- the former effects refuted.*
7. *The Authours solution to the former questions.*
 8. *The reason why in the former case, a lesser loadstone doth draw the interjacent iron from the greater.*
 9. *Why the variation of a touched needle from the north, is greater the nearer you go to the Pole.*
 10. *Whether in the same part of the world a touched needle may at one time vary more from the north, and at another time lesse.*
 11. *The whole doctrine of the loadstone summed up in short.*

CHAP. XXIII.

A description of two sorts of living creatures; Plants and Animals: & how they are framed in common to perform vitall motion.

1. *The connexion of the following Chapters with the precedent ones.*
2. *Concerning severall compositions of mixed bodies.*
3. *Two sorts of living creatures.*
4. *An engine to expresse the first sort of living creatures.*
5. *An other engine by which may be expressed the second sort of living creatures.*
6. *The two former engines and some other comparisons applyed to expresse the two severall sorts of living creatures.*

7. *How plants are framed.*
8. *How sensitive creatures are formed.*

CHAP. XXIII.

A more particular survey of the generation of Animals; in which is discovered what part of the animal is first generated.

1. *The opinion that the seed containeth formally every part of the parent.*
2. *The former opinion rejected.*
3. *The Authours opinion of this question.*
4. *Their opinion refuted, who hold that every thing containeth formally all things.*
5. *The Authours opinion concerning the generation of Animals declared and confirmed.*
6. *That one substance is changed into another.*
7. *Concerning the hatching of chickens, and the generation of other animals.*
8. *From whence it happeneth that the deficiencies or excrescences of the parents body, are often seen in their children.*
9. *The difference between the authours opinion, and the former one.*
10. *That the heart is imbued with the generall specifick virtues of the whole body; whereby is confirmed the doctrine of the two former paragraphs.*

11. *That*

A Table.

II. *That the heart is the first part generated in a living creature.*

CHAP. XXV.

How a Plant or Animal cometh to that figure it hath.

1. *That the figure of an Animal is produced by ordinary second causes, as well as any other corporeall effect.*
2. *That the severall figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrence of accidentall causes.*
3. *The former doctrine is confirmed by severall instances.*
4. *The same doctrine applied to Plants.*
5. *The same doctrine declared in leaſs of trees.*
6. *The same applied to the bodies of Animals.*
7. *In what ſenſe the Authour doth admit of Vis formatrix.*

CHAP. XXVI.

How motion beginneth in living creatures. And of the motion of the heart, circulation of the blood, Nutrition, Augmentation, and corruption or death.

1. *From whence doth proceed the primary motion and growth in Plants.*
2. *Monſieur des Cartes his opi-*

nion touching the motion of the heart.

3. *The former opinion rejected.*
4. *The Authours opinion concerning the motion of the heart.*
5. *The motion of the heart dependeth originally of its fibers irrigated by blood.*
6. *An objection answered againſt the former doctrine.*
7. *The circulation of the blood, & other effects that follow the motion of the heart.*
8. *Of Nutrition.*
9. *Of Augmentation.*
10. *Of death and ſickneſſe.*

CHAP. XXVII.

Of the motions of ſenſe, and of the ſenſible qualities in generall, and in particular of thoſe which belong to Touch, Taſt, and Smelling.

1. *The connexion of the ſubſequent chapters with the precedent.*
2. *Of the ſenſes and ſenſible qualities in generall. And of the end for which they ſerve.*
3. *Of the ſenſe of touching: and that both it and its qualities are bodies.*
4. *Of the taſt and its qualities: that they are bodies.*
5. *That the ſmell and its qualities are reall bodies.*
6. *Of the conformity betwixt the two ſenſes of ſmelling & taſting*
7. *The*

A Table.

7. *The reason why the sense of smelling is not so perfect in man as in beasts: with a wonderfull historie of a man who could wind a sent as well as any beast.*

CHAP. XXVIII.

Of the sense of hearing, and of the sensible quality, sound.

1. *Of the sense of hearing: and that sound is purely motion.*
2. *Of divers arts belonging to the sense of hearing: all which confirm that sound is nothing but motion.*
3. *The same is confirmed by the effects caused by great noises.*
4. *That solid bodies may convey the motion of the aire or sound to the organe of hearing.*
5. *Where the motion is interrupted there is no sound.*
6. *That not onely the motion of the aire, but all other motions coming to our ears make sounds.*
7. *How one sense may supply the want of another.*
8. *Of one who could discern sounds of words with his eyes.*
9. *Divers reasons to prove sound to be nothing else but a motion of some reall body.*

CHAP. XXIX.

Of sight and colours.

1. *That colours are nothing but*

light mingled with darknesse; or the disposition of a bodies superficies apt to reflect light so mingled.

2. *Concerning the disposition of those bodies which produce white or black colours.*
3. *The former doctrine confirmed by Aristotles authority, reason, and experience.*
4. *How the diversity of colours do follow out of various degrees of rarity and density.*
5. *Why some bodies are diaphanous others opacous.*
6. *The former doctrine of colours confirmed by the generation of white and black in bodies.*

CHAP. XXX.

Of luminous or apparent colours.

1. *Apparitions of colours through a prisme or triangular glasse are of two sorts.*
2. *The severall parts of the object make severall angles at their entrance into the prisme.*
3. *The reason why sometimes the same object appears through the prisme in two places: and in one place more lively, in the other place more dimme.*
4. *The reason of the various colours that appear in looking thorough a prisme.*
5. *The reason why the prisme in one position, may make the colours appear quite contrary to what*

- what they did, when it was in another position.
6. The reason of the various colours in generall, by pure light passing through a prisme.
 7. Upon what side every colour appears that is made by pure light passing through a prisme.

CHAP. XXXI.

The causes of certain appearances in luminous colours; with a conclusion of the discourse touching the senses & the sensible qualities

1. The reason of each severall colour in particular caused by light passing through a prisme.
2. A difficult probleme resolved touching the prisme.
3. Of the rainbow, and how by the colour of any body, we may know the composition of the body it self.
4. That all the sensible qualities are real bodies resulting out of severall mixtures of rarity and densitie.
5. Why the senses are onely five in number: with a conclusion of all the former doctrine concerning them.

CHAP. XXXII.

Of sensation, or the motion where-by sense is properly exercised.

1. Monsieur des Cartes his opinion touching sensation.

2. The Authors opinion touching sensation.
3. Reasons to perswade the Authors opinion.
4. That vitall spirits are the immediate instruments of sensation by conveying sensible qualities to the brain.
5. How sound is conveyed to the brain by vitall spirits.
6. How colours are conveyed to the brain by vitall spirits.
7. Reasons against Monsieur des Cartes his opinion.
8. That the symptomes of the palse, do no way confirm Monsieur des Cartes his opinion.
9. That Monsieur des Cartes his opinion, cannot give a good account, how things are conserved in the memory.

CHAP. XXXIII.

Of Memory.

1. How things are conserved in the memory.
2. How things conserved in the memory are brought back into the phantasia.
3. A confirmation of the former doctrine.
4. How things renewed in the phantasia, return with the same circumstances that they had at first.
5. How the memory of things past is lost, or confounded: and how it is repaired again.

CHAP.

CHAP. XXXIV.

Of voluntary motion, naturall faculties, and passions.

1. *Of what matter the brain is composed.*
2. *What is voluntary motion.*
3. *What those powers are which are called naturall faculties.*
4. *How the attractive and secretive faculties work.*
5. *Concerning the concoctive facultie.*
6. *Concerning the retentive and expulsive faculties.*
7. *Concerning expulsion made by Physick.*
8. *How the brain is moved to work voluntary motion.*
9. *Why pleasing objects do dilate the spirits, and displeasing ones contract them.*
10. *Concerning the five senses for what use and end they are.*

CHAP. XXXV.

Of the materiall instrument of Knowledge and Passion; of the severall effects of Passions; of Pain and Pleasure; and how the vitall spirits are sent from the brain into the intended parts of the body, without mistaking their way.

1. *That Septum Lucidum is the seat of the phansie.*
2. *What causeth us to remember*

not onely the object it self, but also that we have thought of it before.

3. *How the motions of the phantasie, are derived to the heart.*
4. *Of pain and pleasure.*
5. *Of Passion.*
6. *Of severall pulses caused by passions.*
7. *Of severall other effects caused naturally in the body by passions*
8. *Of the diaphragma.*
9. *Concerning pain and pleasure caused by the memory of things past.*
10. *How so small bodies as atomes are, can cause so great motions in the heart.*
11. *How the vitall spirits sent from the brain, do runne to the intended part of the body without mistake.*
12. *How men are blinded by passion*

CHAP. XXXVI.

Of some actions of beasts, that seem to be formall acts of reason, as doubting, resolving, inventing,

1. *The order and connexion of the subsequent chapters.*
2. *From whence proceedeth the doubting of beasts.*
3. *Concerning the invention of foxes and other beasts.*
4. *Of foxes that catch hens by lying under their roost, and by gazing upon them.*
5. *From*

A Table.

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| <p>5. <i>From whence proceeds the foxes invention to rid himself of fleas</i></p> <p>6. <i>An explication of two other inventions of foxes.</i></p> <p>7. <i>Concerning Montagues argument, to prove that dogs make syllogismes.</i></p> <p>8. <i>A declaration how some tricks are performed by foxes, which seem to argue discourse.</i></p> <p>9. <i>Of the Jaccatrays invention in calling beasts to himself.</i></p> <p>10. <i>Of the Jaccalls designe in serving the Lion.</i></p> <p>11. <i>Of severall inventions of fishes.</i></p> <p>12. <i>A discovery of divers things done by hares, which seem to argue discourse.</i></p> <p>13. <i>Of a foxe reported to have weighed a goose, before he would venture with it over a river, and of fabulous stories in common.</i></p> <p>14. <i>Of the severall cryings & tones of beasts: with a refutation of those authors who maintain the to have compleat languages.</i></p> | <p>2. <i>Of the Baboon that played on a guitarre.</i></p> <p>3. <i>Of the teaching of Elephants & other beasts to do divers tricks.</i></p> <p>4. <i>Of the orderly train of actions performed by beasts in breeding their young ones.</i></p> |
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C H A P. XXXVIII.

Of prescience of future events, providencies, the knowing of things never seen before; and such other actions, observed in some living creatures, which seem to be even above the reason that is in man himself.

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| <p style="text-align: center;">C H A P. XXXVII.</p> <p>Of the docility of some irrational animals, and of certain continue actions of a long tract of time so orderly performed by them, that they seem to argue knowledge in them.</p> <p>1. <i>How hawkes and other creatures are taught to do what they are brought up to.</i></p> | <p>1. <i>Why beasts are affraid of men.</i></p> <p>2. <i>How some qualities caused at first by chance in beasts, may passe by generation to the whole offspring.</i></p> <p>3. <i>How the parents phantasie doth oftentimes work strange effects in their issue.</i></p> <p>4. <i>Of Antipathies.</i></p> <p>5. <i>Of Sympathies.</i></p> <p>6. <i>That the Antipathy of beasts towards one an other, may be taken away by assuefaction.</i></p> <p>7. <i>Of longing marks seen in childrē.</i></p> <p>8. <i>Why divers men hate some certain meats, & particularly cheese.</i></p> <p>9. <i>Concerning the providence of Ants in laying up in store for winter.</i></p> <p>10. <i>Concerning the foreknowing of beasts.</i></p> <p>The conclusion of the first Treatise.</p> |
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A Table shewing what is contained in the severall
 Chapters and Sections in this second Treatise,
 Concerning MANS SOUL.

CHAP. I.

THe Preface. Of simple Ap-
 prehensions.

1. *What is a right apprehension of a thing.*
2. *The very thing it self is truly in his understanding, who rightly apprehendeth it.*
3. *The apprehension of things coming unto us by our senses, are resolvable into other more simple apprehensions.*
4. *The apprehension of a Being is the most simple and Basis of all the rest.*
5. *The apprehension of a thing is in next degree to that of Being, and it is the Basis of all the subsequent ones.*
6. *The apprehension of things known to us by our senses doth consist in certain respects betwixt two things.*
7. *Respect or relation hath not really any formall being, but onely in the apprehension of man.*
8. *That Existence or Being is the proper affection of man: and that mans soul is a comparing power.*
9. *A thing by coming into the understanding of man, loseth nothing of its own peculiar nature.*

10. *A multitude of things may be united in mans understanding without being mingled or confounded together.*
11. *Of abstracted and concrete terms.*
12. *Of universall notions.*
13. *Of apprehending a multitude under one notion.*
14. *The power of the understanding reacheth as farre as the extent of Being.*

CHAP. II.

Of Thinking and Knowing.

1. *How a judgement is made by the understanding.*
2. *That two or more apprehensions are identified in the soul by uniting them in the stock of being*
3. *How the notions of a substantive and an adjective, are united in the soul by the common stock of Being.*
4. *That a settled judgement becometh a part of our soul.*
5. *How the soul cometh to deem or settle a judgement.*
6. *How opinion is begotten in the understanding.*
7. *How faith is begotten in the understanding.*

CHAP. IV.

How a man proceedeth to action.

8. *Why truth is the perfection of a reasonable soul: and why it is not found in simple apprehensions as well as in Enuntiations.*
9. *What is a solid judgement, and what a slight one.*
10. *What is an acute judgement, and what a dull one.*
11. *In what consisteth quicknesse and clearnesse of judgement: and there opposite vices.*

CHAP. III.

Of Discourfing.

1. *How discourse is made.*
2. *Of the figures and moods of syllogismes.*
3. *That the life of man as man, doth consist in discourse, and of the vast extent of it.*
4. *Of humane actions, and of those that concern our selves.*
5. *Of humane actions as they concern our neighbours.*
6. *Of Logick.*
7. *Of Grammar.*
8. *Of Rhetorick.*
9. *Of Poetry.*
10. *Of the power of speaking.*
11. *Of arts that concern dumbe and insensible creatures.*
12. *Of Arithmetick.*
13. *Of Prudence.*
14. *Observations upon what hath been said in this chapter.*

CHAP. V.

Containing proofs out of our single apprehensions, that our soul is incorporeall.

1. *The connection of the subsequent chapters with the precedent.*
2. *The existence of corporeall things in the soul by the power of apprehension, doth prove her to be immateriall.*
3. *The notion of being, which is innate in the soul, doth prove the same.*
4. *The same is proved by the notion of respects.*

5. *That*

5. That corporeall things are spiritualized in the understanding, by means of the souls working in and by respects.
6. That the abstracting of notions from all particular and individuall accidents, doth prove the immaterialitie of the soul.
7. That the universalitie of abstracted notions do prove the same.
8. That collective apprehensions do prove the same.
9. The operations of the soul drawing alwayes from multitude to unitie, do prove the same.
10. The difference betwixt the notion of a thing in our understanding, and the impression that correspondeth to the same thing in our phansie, doth prove the same.
11. The apprehension of negations & privations do prove the same.

CHAP. VI.

Containing proofs of our souls operations in knowing or deeming any thing, that she is of a spirituall nature.

1. The manner of judging or deeming by apprehending two things to be identified, doth prove the soul to be immateriall.
2. The same is proved by the manner of apprehending opposition in a negative judgement.
3. That things in themselves op-

posite to one another having no opposition in the soul, doth prove the same.

4. That the first truths are identified to the soul.

5. That the soul hath an infinite capacity, and consequently is immateriall.

6. That the opposition of contradictory propositions in the soul doth prove her immaterialitie.

7. How propositions of eternall truth, do prove the immaterialitie of the soul.

CHAP. VII.

That our discoursing doth prove our soul to be incorporeall.

1. That in discoursing the soul containeth more in it at the same time then is in the phantasie, which proveth her to be immateriall.

2. That the nature of discourse doth prove the soul to be ordered to infinite knowledge, and consequently immateriall.

3. That the most naturall objects of the soul are immateriall, & consequently the soul her self is such

CHAP. VIII.

Containing proofs out of our manner of proceeding to action, that our soul is incorporeall.

1. That the souls being a power to order things, proveth her to be immateriall.

A Table.

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| <p>2. That the souls being able to move without being moved, doth prove her to be immateriall.</p> <p>3. That the souls proceeding to action with an universality, and indifferency doth prove the same.</p> <p>4. That the quiet proceeding of reason doth prove the same.</p> <p>5. A conclusion of what hath been said hitherto in this second Treatise.</p> | <p>9. The same is proved from her manner of operation which is grounded in being.</p> <p>10. Lastly, it is proved from the science of Moralitie, the principles whereof would be destroyed, if the soul were mortall.</p> |
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CHAP. X.

Declaring what the soul of a man separated from his body, is : and of her knowledge and manner of working.

CHAP. IX.

That our soul is a Substance, and Immortal.

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| <p>1. That Mans soul is a substance.</p> <p>2. That man is compounded of some other substance besides his body.</p> <p>3. That the soul doth subsist of it self independently of the body.</p> <p>4. Two other arguments to prove the same: one positive, the other negative.</p> <p>5. The same is proved because the soul cannot be obnoxious to the cause of mortality.</p> <p>6. The same is proved because the soul hath no contrary.</p> <p>7. The same is proved from the end, for which the soul was created.</p> <p>8. The same is proved because she can move without being moved.</p> | <p>1. That the soul is one simple knowing act, which is a pure substance, and nothing but substance.</p> <p>2. That a separated soul is in no place, and yet is not absent from any place.</p> <p>3. That a separated soul is not in time, nor subject to it.</p> <p>4. That the soul is an active substance, and all in it is activitie.</p> <p>5. A description of the soul.</p> <p>6. That a separated soul knoweth all that which she knew whilest she was in her body.</p> <p>7. That the least knowledge which the soul acquireth in her body of any one thing, doth cause in her, when she is separated from her body a complete knowledge of all things whatsoever.</p> <p>8. An answer to the objections of some Peripateticks, who main-
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- rain the soul to perish with the body.
9. The former Peripateticks refuted out of Aristotle.
 10. The operations of a separated soul compared to her operations in her body.
 11. That a separated soul is in a state of pure being, and consequently immortal.
5. The state of a vitious soul in the next life.
 6. The fundamentall reason why as well happinesse as misery is so excessive in the next life.
 7. The reason why mans soul requireth to be in a body, and to live for some space of time joynd with it.
 8. That the misery of the soul in the next world proceedeth out of inequality, and not out of falsity of her judgements.

CHAP. XI.

Shewing what effects the divers manners of living in this world do cause in a soul, after she is separated from her body.

1. That a soul in this life is subject to mutation, and may be perfected in knowledge.
2. That the knowledges which a soul getteth in this life, will make her knowledge in the next life more perfect and firm.
3. That the souls of men addicted to science whilest they lived here, are more perfect in the next world, then the souls of unlearned men.
4. That those souls which embrace virtue in this world, will be most perfect in the next; and those which embrace vice, most miserable.

CHAP. XII.

Of the perseverance of a soul, in the state she findeth her self in, at her first separation from her body

1. The explication, and proof of that maxime, that, If the cause be in act, the effect must also be.
2. The effects of all such agents as work instantaneously, are complete in the first instant that the agents are put.
3. All pure spirits do work instantaneously.
4. That a soul separated from her body, cannot suffer any change after the first instant of her separation.
5. That temporall finnes are justly punished with eternall pains.

The Conclusion.

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THE FIRST TREATISE
DECLARING
THE NATURE AND
OPERATION OF
BODIES.

CHAP. I.

*A Preamble to the whole discourse: Concerning
Notions in generall.*

IN delivering any Science, the clearest and smoothest methode, and most agreeable to nature, is to begin with the consideration of those things that are most common and obvious; and by the dissection of them to descend by orderly degrees and steps (as they lie in the way) unto the examination of the most particular and remote ones. Now in our present intended survey of a Bodie, the first thing which occurreth to our sense in the perusall of it, is its *Quantitie*, bulk, or magnitude: and this seemeth by all mankind to be conceived so inseparable from a body, as when a man would distinguish a corporeall substance from a spirituall one (which is accounted indivisible) he naturally pitcheth upon an apprehension of its having bulk, and being solid, tangible, and apt to make impression upon our outward senses; according to that expression of Lucretius, who studying Nature in a familiar and rationall manner telleth us, *Tangere enim & tangi, nisi corpus nulla potest res*: And therefore in our inquiry of Bodies, we will observe that plain methode which Nature teacheth us, and will begin with examining, *What Quantity is*, as being their

I.
Quantitie is the first and most obvious affection of a Body.

first and primary affection; and that which maketh the things we treat of, be what we intend to signifie by the name of Body.

2.
Words do not
expresse things
as they are in
themselves, but
onely as they
are painted in
the minds of
men.

But because there is a great variety of apprehensions framed by learned men of the nature of *Quantity* (though indeed nothing can be more plain and simple then it is in it self) I conceive it will not be amisse, before we enter into the explication of it, to consider how the mysterie of discoursing and expressing our thoughts to one another by words (a prerogative belonging onely to man) is ordered and governed among us; that so we may avoid those rocks, which many and for the most part, such as think they spin the finest thrids, do suffer shipwrack against in their subtilest discourses. The most dangerous of all which, assuredly is, when they confound the true and reall natures of things, with the conceptions they frame of them in their own minds. By which fundamentall miscarriage of their reasoning, they fall into great errors and absurdities: and whatsoever they build upon so ruinous a foundation, proveth but uselesse cobwebs or prodigious Chymeras. It is true, words serve to expresse things; but if you observe the matter well, you will perceive they do so, onely according to the pictures we make of them in our own thoughts, and not according as the things are in their proper natures. Which is very reasonable it should be so, since the soul, that giveth the names, hath nothing of the things in her but these notions: and knoweth not the things otherwise then by these notions; and therefore cannot give other names but such as must signifie the things by mediation of these notions. In the things, all that belongeth unto them is comprised under one entire Entity: but in us, there are framed as many severall distinct formall conceptions, as that one thing sheweth it self unto us with different faces. Every one of which conceptions seemeth to have for its object a distinct thing, because the conception it self is as much severed and distinguished from another conception or image, arising out of the very same thing that begot this, as it can be from any image painted in the understanding by an absolutely other thing.

3.
The first error
that may arise
from hence,

It will not be amisse to illustrate this matter by some familiar example. Imagine I have an apple in my hand: the same fruit worketh different effects upon my severall senses: my eye telleth

telleth me it is green or red: my nose that it hath a mellow sent: my taste that it is sweet, and my hand that it is cold and weightie. My senses thus affected, send messengers to my phantasie with news of the discoveries they have made: and there, all of them make severall and distinct pictures of what entereth by their doors. So that my Reason (which discourseth upon what it findeth in my phantasie) can consider greenesse by it self, or mellownesse, or sweetnesse, or coldnesse, or any other quality whatsoever, singly and alone by it self, without relation to any other that is painted in me by the same apple: in which, none of these have any distinction at all, but are one and the same substance of the apple, that maketh various and different impressions upon me, according to the various dispositions of my severall senses: as hereafter we shall explicate at large. But in my mind, every one of these notions is a distinct picture by it self, and is as much severed from any of the rest arising from the same apple, as it would be from any impression or image made in me; by a stone or any other substance whatsoever, that being entire in it self and circumscribed within its own circle, is absolutely sequestred from any communication with the other: so that what is but one entire thing in it self, seemeth to be many distinct things in my understanding: whereby, if I be not very cautious, and in a manner wrestle with the bent and inclination of my understanding (which is apt to referre the distinct and complete stamp it findeth within it self, unto a distinct and complete originall character in the thing) I shall be in danger before I am aware, to give actuall Beings to the quantity, figure, colour, smell, taste, and other accidents of the apple, each of them distinct one from another, as also from the substance which they clothe; because I find the notions of them really distinguished (as if they were different Entities) in my mind. And from thence I may inferre, there is no contradiction in nature to have the accidents really severed from one another, and to have them actually subsist without their substance: and such other mistaken subtilties, which arise out of our unwary conceiting that things are in their own natures after the same fashion as we consider them in our understanding.

which is a multiplying of things, where no such multiplication is really found.

4. A second error; the conceiving of many distinct things as really one thing.

And this course of the minds disguising and changing the impressions it receiveth from outward objects, into appearances quite differing from what the things are in their own reall natures; may be observed not onely in multiplying Entities where in truth there is but one: but also in a contrary manner, by comprising severall distinct things under one single notion; which if afterwards it be reflected back upon the things themselves, is the occasion of exceeding great errors, and entangleth one in unsuperable difficulties. As for example: Looking upon severall cubes or deyes, wherof one is of gold, another of lead, a third of ivory, a fourth of wood, a fifth of glasse, and what other matter you please; all these severall things agree together in my understanding, and are there comprehended under one single notion of a cube; which (like a painter that were to designe them onely in black and white) maketh one figure that representeth them all. Now if removing my consideration from this impression which the severall cubes make in my understanding, unto the cubes themselves, I shall unwarily suffer my self to pin this one notion upon every one of them, and accordingly conceive it to be really in them; it will of necessity fall out by this misapplying of my intellectuall notion to the reall things, that I must allow Existence to other entities, which never had nor can have any in nature.

From this conception, Plato's Ideas had their birth; for he finding in his understanding one universall notion that agreed exactly to every individuall of the same species of substance, which imprinted that notion in him; and conceiving that the picture of any thing must have an exact correspondence with the thing it representeth; and not considering that this was but an imperfect picture of the individuall that made it: he did thence conceive, there was actually in every individuall substance one universall Nature running through all of that species, which made them be what they were. And then considering that corporeity, quantity, and other accidents of matter, could not agree with this universall subsistent Nature, he denied all those of it: and so, abstracting from all materiality in his Ideas, and giving them a reall & actuall subsistence in nature, he made them like Angels, whose essences and formall reasons were to be
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the Essence and to give Existence unto corporeall individuals: and so each Idea was embodied in every individuall of its species. Unto which opinion (and upon the same grounds) Averroes did lean, in the particular of mens souls. Likewise Scotus finding in his understanding an universall notion springing from the impressiō that individuals make in it, will have a like universall in the thing it self, so determining universals (to use his own language and terms) to be *à parte rei*; and expressing the distinction they have from the rest of the thing, by the terms of *actu formaliter, sed non realiter*: and thereby maketh every individuall comprise an universall subsistent nature in it. Which inconvenience other modern Philosophers seeking to avoid, will not allow these universalls a reall and actuall subsistence; but will lend them onely a fictitious Being, so making them as they call them *Entia rationis*. But herein again they suffer themselves to be carried down the stream before they are aware by the understanding (which is apt to pin upon the objects, the notions it findeth within it self resulting from them) and do consider an unity in the things which indeed is onely in the understanding.

Therefore one of our greatest cares in the guidance of our discourse, and a continuall and sedulous caution therein, ought to be used in this particular, where every error is a fundamentall one, and leadeth into inextricable labyrinths, and where that which is all our level to keep us upright and even (our understanding) is so apt, by reason of its own nature and manner of operation, to make us slide into mistaking and error. And to summe up in short what this discourse aimeth at, we must narrowly take heed, lest reflecting upon the notions we have in our mind, we afterwards pin those airy superstructures upon the materiall things themselves, that begot them; or frame a new conception of the nature of any thing by the negotiation of our understanding, upon those impressions which it self maketh in us: whereas we should acquiesce and be content with that naturall and plain notion, which springeth immediately and primarily from the thing it self: which when we do not, the more we seem to excell in subtilty, the further we go from reality and truth; like an arrow, which being wrong levelled at hand, falleth widest when shot in the strongest bow.

5.
Great care to be taken to avoid the errors which may arise from our manner of understanding things.

6.

Two sorts of words to expresse our notions; the one common to all men, the other proper to scholars.

Now to come to another point that maketh to our present purpose. We may observe there are two sorts of language to expresse our notions by: The one belongeth in generall to all mankind, and the simplest person, that can but apprehend and speak sense, is as much judge of it as the greatest Doctor in the schools: and in this, the words expresse the things properly and plainly, according to the naturall conceptions that all people agree in making of them. The other sort of language is circled in with narrower bounds; and is understood onely by those that in a particular and expresse manner have been trained up unto it: and many of the words which are proper to it have been, by the authours of it, translated and wrested from the generall conceptions of the same words, by some metaphore, or similitude, or allusion, to serve their private turns. Without the first manner of expressing our notions, mankind could not live in society together, and converse with one another: whereas, the other hath no further extent, then among such persons as have agreed together to explicate and designe among themselves particular notions peculiar to their arts and affairs.

Of the first kind, are those tenne generall heads, which Aristotle calleth Predicaments: under which he (who was the most judicious orderer of notions, and directour of mens conceptions that ever lived) hath comprised whatsoever hath, or can have, a being in nature. For when any object occurreth to our thoughts, we either consider the essentiall and fundamentall Being of it; or we referre it to some species of Quantitie; or we discover some qualities in it; or we perceive that it doeth, or that it suffereth something; or we conceive it in some determinate place, or time, and the like. Of all which, every man living that enjoyeth but the use of reason findeth naturally within himself at the very first naming of them, a plain, complete, and satisfying notion; which is the same without any the least variation, in all mankind; unlesse it be in such, as have industriously, and by force, and with much labour, perplexed and depraved those primary and sincere impressions, which nature had freely made in them.

Of the second sort, are the particular words of art by which

which learned men use to expresse what they mean in Sciences; and the names of instruments, and of such things as belong to trades, and the like: as a sine, a tangent, an epicycle, a deferent, an axe, a trowell, and such others; the intelligence of which belongeth not to the generality of mankind; but onely to Geometricians, Astronomers, Carpenters, Masons, and such persons as converse familiarly and frequently with those things. To learn the true signification of such words, we must consult with those that have the knowledge and practise of them: as in like manner, to understand the other kind of plain language, we must observe how the words that compose it are apprehended, used, and applied by mankind in generall; and not receive into this examination the wrested or Metaphoricall senses of any learned men, who seek oftentimes (beyond any ground in nature) to frame a generall notion that may comprehend all the particular ones, which in any sense, proper or improper, may arise out of the use of one word.

And this is the cause of great errors in discourse; so great and important, as I cannot too much inculcate the caution requisite to the avoyding of this rock. Which that it may be the better apprehended, I will instance in one example of a most plain and easie conception wherein all mankind naturally agreeth, how the wresting it from its proper, genuine, and originall signification, leadeth one into strange absurdities; and yet they passe for subtill speculations. The notion of being in a place, is naturally the same in all men living: ask any simple artisan, Where such a man, such a house, such a tree, or such a thing is; and he will answer you in the very same manner as the learnedest Philosopher would do: he will tell you, the man you ask for, is in such a church, sitting in such a piew, and in such a corner of it; that the house you inquire after, is in such a street, and next to such two buildings on each side of it; that the tree you would find out, is in such a forest, upon such a hill, near such a fountain, and by such a bush; that the wine you would drink of, is in such a cellar, in such a part of it, and in such a cask. In conclusion, no man living that speaketh naturally and freely out of the notion he findeth clearly in his understanding, will give you

7.
Great errors arise by wresting words from their common meaning to expresse a more particular or studied notion.

other answer to the question of, *where a thing is*, then such a one as plainly expresseth his conceit of being in place, to be no other, then a bodies being environed and inclosed by some one, or severall others that are immediate unto it; as the place of a liquour, is the vessell that containeth it; and the place of the vessell, is such a part of the chamber or house that it resteth upon, together with the ambient aire; which hath a share in making up the places of most things. And this being the answer, that every man whatsoever will readily give to this question; and every asker being fully satisfied with it; we may safely conclude, That all their notions and conceptions of being in a place, are the same; and consequently, that it is the naturall and true one.

But then some others, considering that such conditions as these will not agree unto other things, which they likewise conceit to be in a place (for they receive it as an axiome from their sense, that whatsoever is, must be somewhere, and whatsoever is no where, is not at all) they fall to casting about how they may frame some common notion to comprehend all the severall kinds of being in place, which they imagine in the things they discourse of. If there were nothing but bodies to be ranked by them in the Predicament of Place, then that description I have already set down would be allowed by them, as sufficient. But since that spirits and spirituall things (as Angels, rationall souls, verities, sciences, arts, and the like) have a being in nature; and yet will not be comprised in such a kind of place as a body is contained in; they rack their thoughts to speculate out some common notion of being in place, which may be common to these, as well as to bodies; like a common accident agreeing to diverse subjects. And so in the end they pitch upon an Entity, which they call an *Ubi*: and they conceit the nature and formall reason of that to be, the ranking of any thing in a place, when that Entity is thereunto affixed. And then they have no further difficulty, in settling an Angell, or any pure spirit, or immateriall essence, in a place as properly, and as completely, as if it were a corporeall substance. It is but assigning an *Ubi* to such a spirit, and he is presently riveted to what place you please: and by multiplying the *Ubies*,

any individuall body unto which they are assigned, is at the same instant in as many distant places, as they allot it different Ubies: and if they assigne the same Ubi to severall bodies, so many severall ones as they assigne it unto will be in one and the same place: and not onely many bodies in one place, but even a whole bodie in an indivisible, by a kind of Ubi that hath a power to resume all the extended parts and inclose them in a point of place. All which prodigious conceits and impossibilities in nature. do spring out of their mistake in framing Metaphysicall and abstracted conceptions, instead of contenting themselves with those plain, easie, and primary notions, which nature stampeth alike in all men of common sense, and understanding. As who desireth to be further instructed in this particular, may perceive, if he take the pains to look over what M. White hath discoursed of *Place*, in the first of his Dialogues *De Mundo*. Unto which book I shall from time to time (according as I shall have occasion) referre my Reader in those subjects the Authour taketh upon him to prove; being confident that his Metaphysicall demonstrations there, are as firm as any Mathematicall ones (for Metaphysicall demonstrations have in themselves as much firmnesse, certainty and evidencie as they) and so will appear as evident as they, unto whosoever shall understand them thoroughly, and shall frame right conceptions of them: which (how plain soever they seem to be) is not the work of every pretender to learning.

CHAP. II.

Of Quantitie.

AMong those primary affections which occurre in the perusal of a body, *Quantitie* (as I have observed in the precedent chapter) is one, and in a manner the first and the root of all the rest. Therefore (according to the caution we have been so prolix in giving, because it is of so main importance) if we aim at right understanding the true nature of it, we must examine, what apprehension all kinds of people (that is, mankind in generall) maketh of it. By which proceeding, we do not make the ignorant multitude judge of that learning which groweth out of the consideration of *Quantitie*: but onely

I.

We must know the vulgar and common notion of *Quantitie* that we may understand the nature of it.

ly of the naturall notion which serveth learned men for a basis and foundation to build scientificall superstructures upon. For although sciencies be the works and structures of the understanding governed and levelled by the wary and strict rules of most ingenuous artificers, yet the ground upon which they are raised, are such plain notions of things, as naturally and without any art, do present themselves to every mans apprehension: without which for matter to work upon, those artificiall reflections would leave the understanding as unsatisfied, as a cook would the appetite by a dish upon which he should have exercised all his art in dressing it, but whose first substance were not meat of solid nutriment: it is the course market that must deliver him plain materialls to employ his cunning upon: And in like manner, it is the indisciplined multitude that must furnish learned men with naturall apprehensions and notions to exercise their wits about: which when they have, they may use and order and reflect upon them as they please: but they must first receive them in that plain and naked form, as mankind in generall pictureth them out in their imaginations.

And therefore the first work of scholars is to learn of the people, *Quem penes, arbitrium est & jus & norma loquendi*, what is the true meaning and signification of these primary names, and what notions they beget: in the generality of mankind of the things they designe. Of the common people then we must enquire *What Quantity is*: and we shall soon be informed, if we but consider what answer any sensible man will make upon the sudden to a question whereof that is the subject: for such unstudied replies expresse sincerely the plain and naturall conceptions which they that make them have of the things they speak of. And this of *Quantity* is the plainest and the first that nature printeth in us, of all the things we see, feel, and converse withall; and that must serve for a ground unto all our other inquiries and reflections: for which cause we must be sure not to receive it wrested or disguised from its own nature.

2.

Extension or
divisibility is
the common
notion of Quan-
tity.

If then any one be asked; What *Quantitie* there is in such a thing, or how great it is; he will presently in his understanding compare it with some other thing. (equally known by both parties)

parties) that may serve for a measure unto it; and then answer, That it is as big as it, or twice as big, or not half so big, or the like: in fine, that it is bigger or lesser then another thing, or equal to it.

It is of main importance to have this point thoroughly and clearly understood; therefore it will not be amisse to turn it and view it a little more particularly. If you ask what quantity there is of such a parcell of cloth, how much wood in such a piece of timber, how much gold in such an ingot, how much wine in such a vessel, how much time was taken up in such an action? he that is to give you an account of them measureth them by ells, by feet, by inches, by pounds, by ounces, by gallons, by pints, by dayes, by houres, and the like; and then telleth you, how many of those parts are in the whole that you enquire of. Which answer, every man living will at the instant, without study, make to this question; and with it, every man that shall ask will be fully appayed and satisfied; so that it is most evident, it fully expresth the notions of them both, and of all mankind, in this particular.

Wherefore, when we consider that *Quantity* is nothing else, but the extension of a thing; and that this extension is expressed by a determinate number of lesser extensions of the same nature; (which lesser ones, are sooner and more easily apprehended then greater; because we are first acquainted and conversant with such; and our understanding graspeth, weigheth and discerneth such more steadily; and maketh an exacter judgement of them) and that such lesser ones are in the greater which they measure, as parts in a whole; and that the whole by comprehending those parts, is a mere capacity to be divided into them; we conclude, That *Quantity* or *Bignesse*, is nothing else but divisibility; and that a thing is big, by having a capacity to be divided, or (which is the same) to have parts made of it.

This is yet more evident (if more may be) in *Discrete Quantity* (that is, in *number*) then in continued *Quantity*, or extension. For if we consider any number whatsoever, we shall find the essence of it consisteth in a capacity of being resolved and divided into so many unities, as are contained in it; which are the parts of it. And this species of *Quantity* being simpler then the other, serveth for a rule to determine it by; as we may observe

observe in the familiar answers to questions of continued Quantity, which expresse by number the content of it : as when one delivereth the Quantity of a piece of ground, by such a number of furlongs, acres, perches, or the like.

3.
Parts of Quantity are not actually in their whole.

But we must take heed of conceiving, that those parts, which we consider to discern the nature of Quantity, are actually and really in the *whole* of any continued one that containeth them. Ells, feet, inches, are no more reall Entities in the *whole* that is measured by them, and that maketh impressions of such notions in our understanding ; then in our former example, colour, figure, mellownesse, tast, and the like, are severall substances in the apple that affecteth our severall senses with such various impressions. It is but one *whole*; that may indeed be cut into so many severall parts : but those parts are not really there, till by division they are parcelled out : and then, the *whole* (out of which they are made) ceaseth to be any longer : and the parts succeed in lieu of it; and are every one of them a new *whole*.

This truth is evident out of the very definition we have gathered of Quantity. For since it is *divisibility* (that is, a bare capacity to division) it followeth, that it is not yet divided; and consequently, that those parts are not yet in it, which may be made of it; for division, is the making two or more things of one.

4.
If parts were actually in their whole, Quantity would be composed of indivisibles.

But because this is a very great controversie in schools, and so important to be determined and settled, as without doing so, we shall be lyable to main errors in searching the nature and operations of bodies; and that the whole progresse of our discourse, will be uncertain and wavering, if this principle and foundation be not firmly laid ; we must apply our selves, to bring some more particular and immediate proof of the verity of this assertion. Which we will do, by shewing the inconvenience, impossibility and contradiction, that the admittance of the other leadeth unto. For if we allow actuall parts to be distinguished in Quantity, it will follow that it is composed of points or indivisibles, which we shall prove to be impossible.

The first will appear thus : if Quantity were divided into all the parts into which it is divisible, it would be divided into indivisibles (for nothing divisible, and not divided, would remain in it) but it is distinguished into the same parts, into which it

it would be divided, if it were divided into all the parts into which it is divisible; therefore it is distinguished into indivisibles. The major proposition is evident to any man that hath eyes of understanding. The minor, is the confession or rather the position of the adversary, when he saith that all its parts are actually distinguished: The consequence cannot be calumniated, since that indivisibles, whether they be separated or joynd, are still but indivisibles; though that which is composed of them be divisible. It must then be granted that all the parts which are in Quantity, are indivisibles; which parts being actually in it, and the whole being composed of these parts onely, it followeth, that Quantity is composed and made of indivisibles.

If any should cavill at the supposition, and say, we stretch it further then they intend it, by taking *all* the parts to be distinguished; whereas they mean onely that there are parts actually in Quantity, abstracting from *all*: by reason that *all*, in this matter, would inferre an infinity, which to be actually in any created thing, they will allow to be impossible. Our answer will be, to represent unto them how this is barely said, without any ground or colour of reason, merely to evade the inconvenience that the argument driveth them unto. For if any parts be actually distinguished, why should not all be so? What prerogative have some that the others have not? And how came they by it? If they have their actuall distinction out of their nature of being parts, then all must enjoy it alike, and all be equally distinguished, as the supposition goeth: and they must all be indivisibles as we have proved. Besides to prevent the cavill upon the word *all*, we may change the expression of the Proposition into a negative: for if they admit (as they do) that there is no part in Quantity, but is distinguished as farre as it may be distinguished, then the same conclusion followeth with no lesse evidence; and all will prove indivisibles, as before.

But it is impossible that indivisibles should make Quantity; for if they should, it must be done either by a finite and determinate number, or by an infinite multitude of them. If you say by a finite; let us take (for example) three indivisibles, and by adding them together, let us suppose a line to be composed; whose extent being onely longitude, it is the first and simplest species of Quantity, and therefore whatsoever is divisible into parts,

5.

Quantity cannot be composed of indivisibles.

parts, must be at the least a line. This line thus made, cannot be conceived to be divided into more parts then into three; since doing so you reduce it into the indivisibles that composed it. But Euclide hath demonstratively proved beyond all cavill (in the tenth proposition of his sixth book of Elements) that any line whatsoever may be divided into whatsoever number of parts; so that if this be a line, it must be divisible into a hundred or a thousand; or a million of parts: which being impossible in a line, that being divided into three parts onely, every one of those three is incapable of further division: it is evident, that neither a line, nor any Quantity whatsoever, is composed or made of a determinate number of indivisibles.

And since that this capacity of being divisible into infinite parts, is a property belonging to all extension (for Euclides demonstration is universall) we must needs confesse that it is the nature of indivisibles, when they are joynd together, to be drowned in one another, for otherwise there would result a kind of extension out of them, which would not have that property; contrary to what Euclide hath demonstrated. And from hence it followeth that Quantity cannot be composed of an infinite multitude of such indivisibles; for if this be the nature of indivisibles, though you put never so great a number of them together, they will still drown themselves all in one indivisible point. For what difference can their being infinite, bring to them, of such force as to destroy their essence and property? If you but consider how the essentiall composition of any multitude whatsoever, is made by the continuall addition of unities, till that number arise; it is evident in our case that the infinity of indivisibles must also arise, out of the continued addition of still one indivisible to the indivisibles presupposed: then let us apprehend a finite number of indivisibles, which (according as we have proved) do make no extension; but are all of them drowned in the first; and observing how the progresse unto an infinite multitude, goeth on by the steps of one and one, added still to this presupposed number: we shall see that every indivisible added, and consequently the whole infinity, will be drowned in the first number, as that was in the first indivisible.

Which will be yet plainer, if we consider that the nature of extension

extension requireth that one part be not in the same place, where the other is: then if this extension be composed of indivisibles, let us take two points of place in which this extension is, and inquire whether the indivisibles that are in each one of these points, be finite or infinite. If it be answered that they are finite, then the finite indivisibles in these two points make an extension; which we have proved impossible. But if they be said to be infinite; then infinite indivisibles are drowned in one point, and consequently have not the force to make extension. Thus then it remaineth firmly established, *That Quantity is not composed of indivisibles.* (neither finite, nor infinite ones) and consequently, *That parts are not actually in it.*

Yet before we leave this point, although we have already been somewhat long about it, I conceive it will not be tedious, if we be yet a little longer, and bend our discourse to remove a difficulty that even Sense it self seemeth to object unto us. For doth not our eye evidently inform us, there are fingers, hands, arms, legs, feet, toes and variety of other parts in a mans body? These are actually in him, and seem to be distinct things in him, so evidently, that we cannot perswaded, but that we see, and feel the distinction between them; for every one of them hath a particular power of actuall working and doing what belongeth unto its nature to do: each finger is really there; the hand is different from the foot; the leg from the arm; and so of the rest. Are not these parts then actually and really in a mans body? And is not each of them as really distinguished from any other?

This appeareth at the first sight to be an insuperable objection, because of the confirmation and evidence that sense seemeth to give it. But looking nearly into the matter, we shall find that the difficulty ariseth not from what sense informeth us of; but from our wrong applying the conditions of our notions unto the things that make impressions upon our sense. Sense judgeth not which is a finger, which is a hand, or which is a foot. The notions agreeing to these words, as well as the words themselves, are productions of the understanding: which considering severall impressions made upon the sense by the same thing as it hath a virtue and power to severall operations, frameth severall notions of it: as in our former example, it doth

6.
An objection to prove that parts are actually in Quantity; with a declaration of the mistake from whence it proceedeth.

of colour, figure, tast, and the like, in an apple. For as these are not different bodies or substances, distinguished one from another; but are the same one entire thing, working severally upon the senses, and that accordingly, maketh these different pictures in the mind; which are there as much distinguished, as if they were pictures of different substances. So, the parts which are considered in Quantity, are not divers things: but are onely a virtue or power to be divers things: which virtue, making severall impressions upon the senses, occasioneth severall notions in the understanding: and the understanding is so much the more prone to conceive those parts as distinct things, by how much Quantity is nearer to be distinct things, then the qualities of the apple are. For Quantity, is a possibility to be made distinct things by division: whereas the others, are but a virtue to do distinct things. And yet (as we have touched above) nothing can be more manifest, then that if Quantity be divisibility (which is a possibility, that many things may be made of it) these parts are not yet divers things. So that, if (for example) a rod be laid before us, and half of it be hid from our sight, and the other half appear; it is not one part or thing that sheweth it self, and another part or thing that doth not shew it self: but it is the same rod or thing, which sheweth it self according to the possibility of being one new thing, but doth not shew it self according to the possibility of being the other of the two things it may be made by division. Which example if it be well considered will make it much more easily sink into us, that a hand, or eye, or foot, is not a distinct thing by it self; but that it is the man, according as he hath a certain virtue or power in him to distinct operations. For if you sever any of these parts from the whole body, the hand can no more hold; nor the eye see; nor the foot walk; which are the powers that essentially constitute them to be what they are: and therefore they are no longer a hand, an eye, or a foot.

7.

The solution of the former objection: and that Sense cannot discern whether one part be distinguished from another, or no.

Now then to come to the objection; let us examine how farre Sense may be allowed to be judge in this difficulty; and we shall find, that Sense cannot determine any one part in a body: for if it could, it would precisely tell, where that part beginneth or endeth: but it being agreed upon that it beginneth and endeth in indivisibles; it is certain, that Sense cannot determine of them.

If then sense cannot determine any one part, how shall it see that it is distinguished from all other parts? Again; considering that all that whereof sense is capable is divisible, it still telleth us, that in all it seeth, there are more parts then one: and therefore it cannot discern, nor inform us of any that is one alone: nor knoweth what it is to be one; for it never could discern it: but what is many, is many *ones* and cannot be known, by that, which knoweth not, what it is to be one: and consequently sense cannot tell us, that there are many. Wherefore it is evident, that we may not rely upon sense for this question. And as for reason, she hath already given her verdict.

So that nothing remaineth but to shew, why we talk as we do, in ordinary discourse, of many parts: and that what we say in that kind, is true, notwithstanding the unity of the thing. Which will appear plainly, if we consider that our understanding hath a custome for the better discerning of things, to impose upon a thing as it is under one notion, the exclusion of it self as it is under other notions. And this is evident unto all schollars, when the mark of exclusion is expressly put: as when they speak of a white thing, adding the reduplication, *as it is white*: which excludeth all other considerations of that thing besides the whiteneffe of it: but when it cometh under some particular name of the thing, it may deceive those that are not cunning: though indeed, most men discover it in such names as we call abstracted; as humanity, animality, and the like. But it easily deceiveth when it cometh in concrete names; as it doth in the name of *Part* in generall, or in the names of particular parts; as a hand, an eye, an inch, an elle, and others of the like nature: for as you see that a part excludeth both the notion of the whole, and of the remaining parts; so doth a hand, an eye, an elle, exclude all the rest of that thing, whereof the hand is a hand, and the elle is an elle, and so forth. Now then, as every man seeth evidently that it cannot be said, the wall as it is white is plaster or stone: no more can it be said, that the hand of a man is his foot; because the word *hand* signifieth as much in it self, as if the man were taken, by reduplication, to be the man as he is hand, or as he hath the power of holding. So likewise, in the rod we spoke of before; it cannot be said that the part seen is the part unseen; because the part

seen, signifieth the rod as it is a possibilitie to be made by division such a thing, as it appeareth to the sight. And thus it is clear how the difficulty of this point, ariseth out of the wrongfull applying the conditions of our notions, and of names, to the objects and things which we know: whereof we gave warning in the beginning.

Chap. 1. §. 2. 3
8.

An enumeration of the severall specieses of Quantity, which confirmeth that the essence of it is divisibilitie.

After which there remaineth no more to be said of this subject, but to enumerate the severall specieses of Quantitie, according to that division which Logicians for more facilitie of discourse have made of it. Namely, these six, magnitude, place, motion, time, number, and weight. Of which, the two first are permanent, and lie still exposed to the pleasure of whosoever hath a mind to take a survey of them. Which he may do by measuring what parts they are divisible into; how many ells, feet, inches, a thing is long broad or deep; how great a place is; whether it be not bigger or lesser then such another; and by such considerations as these; which do all agree in this, that they expresse the essence of those two specieses of Quantitie, to consist in a capacity of being divided into parts.

The two next; motion and time; though they be of a fleeting propriety, yet it is evident that in regard of their originall and essentiall nature, they are nothing else but a like divisibilitie into parts; which is measured by passing over so great or so little distance; and by years, dayes, hours, minutes, and the like. Number we also see is of the same nature; for it is divisible into so many determinate parts, and is measured by unities, or by lesser numbers so or so often contained in a proposed greater. And the like is evident of weight, which is divisible into pounds, ounces, drammes, or grains; and by them is measured. So that looking over all the severall specieses of Quantitie; it is evident, our definition of it is a true one, and expresseth fully the essence of it, when we say it is *divisibilitie*, or a capacity to be divided into parts; and that no other notion whatsoever, besides this, reacheth the nature of it.

CHAP. III.

Of Raritie and Densitie.

I Intend in this Chapter to look as farre as I can into the nature and causes of the two first differences of bodies which follow out of Quantitie as it concurrerth with substance to make a body: for, the discovery of them, and of the various proportions of them among themselves, will be a great and important step in the journey we are going. But the scarcitie of our language is such, in subjects removed from ordinary conversation, (though in others, I thin k none is more copious or expressive) as affordeth us not apt words of our own to expresse significantly such notions as I must busie my self about in this discourse. Therefore I will presume to borrow them from the Latine school, where there is much ado about them. I would expresse the difference between bodies, that under the same measures and outward bulk, have a greater thinnesse and expansion, or thicknesse and soliditie, one then another; which terms, (or any I can find in English) do not signifie fully those affections of Quantitie that I intend here to declare: therefore I will do it under the names of Raritie and Densitie; the true meaning of which will appear by what we shall hereafter say.

I
What is meant
by Rarity and
Densitie.

It is evident unto us, that there are different sorts of bodies, of which though you take equall quantities in one regard, yet they will be unequall in another. Their magnitudes may be the same, but their weights will be different; or contrariwise, their weights being equall, their outward measures will not be so. Take a pinte of aire; and weigh it against a pinte of water, and you will see the ballance of the last go down amain: but if you drive out the aire by filling the pinte with lead, the other pinte in which the water is, will rise again as fast: which if you poure out, and fill that pinte with quicksilver, you will perceive the lead to be much lighter: and again, you will find a pinte of gold heavier then so much Mercurie. And in like manner, if you take away of the heaive bodies till they agree in weight with the lighter, they will take up & fill different proportions, and parts of the measure that shall contain them.

2.
It is evident
that some bo-
dies are rare
and others
dense; though
obscure, how
they are such.

But from whence this effect ariseth, is the difficultie that we

would lay open. Our measures tell us their quantities are equall, and reason assureth us, there cannot be two bodies in one and the same place; therefore when we see that a pinte of one thing outweigheth a pinte of another that is thinner, we must conclude that there is more body compacted together in the heavier thing than in the light: for else how could so little of a solide or dense thing be stretched out to take up so great room, as we see in a basin of water that being rarified into smoke or aire, filleth a whole chamber? and again, shrink back into so little room, as when it returneth into water, or is contracted into ice? But how this comprehension of more body in equall room is effected, doth not a little trouble Philosophers.

3.
A brief enumeration of the severall properties belonging to the rare and dense bodies.

To find a way that may carry us through these difficulties that arise out of the Rarity and Density of bodies, let us do as Astronomers when they enquire the motions of the Spheres and Planets: they take all the Phenomena or severall appearances of them to our eyes; and then attribute to them such orbs, courses, and periods, as may square and fit with every one of them; and by supposing them, they can exactly calculate all that will ever after happen to them in their motions. So let us take into our consideration the chief properties of rare and dense bodies, and then cast with our selves to find out an hypothesis or supposition (if it be possible) that may agree with them all.

First, it seemeth unto us that dense bodies have their parts more close and compacted then others have that are more rare and subtil. Secondly, they are more heavy then rare ones. Again, the rare are more easily divided then the dense bodies: for water, oyl, milk, honey, and such like substances will not onely yield easily to any harder thing that shall make its way through them; but they are so apt to division and to lose their continuity, that their own weights will overcome and break it: whereas in iron, gold, marble, and such dense bodies, a much greater weight and force is necessary to work that effect. And indeed if we look well into it, we shall find that the rarer things are as divisible in a lesser Quantity, as the more dense are in a greater: and the same force will break the rarer thing into more and lesser parts, then it will an equall one that is more dense. Take a stick of light wood of such a bignesse

ness that being a foot long, you may break it with your hands, and another of the same bignesse, but of a more heavie and compacted wood, and you shall not break it, though it be two foot long: and with equall force you may break a loaf of bread into more and lesse parts, then a lump of lead that is of the same bignesse. Which also will resist more to the division of fire (the subtillest divider that is) then so much water will; for the little atomes of fire (which we shall discourse of hereafter) will pierce and cut out in the water, almost as little parts as themselves, and mingling themselves with them they will flie away together, and so convert the whole body of water into subtile smoke: whereas the same Agent, after long working upon lead, will bring it into no lesse parts then small grains of dust, which it calcineth it into. And gold, that is more dense then lead, resisteth peremptorily all the dividing power of fire; and will not at all be reduced into a calx or lime, by such operation as reduced lead into it.

So that remembering how the nature of Quantity is Divisibility; and considering that rare things are more divisible then dense ones; we must needs acknowledge that the nature of quantity is some way more perfectly in things that are rare, then in those that are dense. On the other side, more compacted and dense things, may haply seem to some to have more Quantity then those that are rare; and that it is but shrunk together: which may be stretched out and driven into much greater dimensions then the Quantity of rare things, taking the quantities of each of them equall in outward appearance. As gold may be beaten into much more and thinner leaf, then an equall bulk of silver or lead. A wax candle will burn longer with equall light, then a tallow candle of the same bignesse; and consequently, be converted into a greater quantity of fire and aire. Oyl will make much more flame then spirit of wine, that is farre rarer then it.

These and such like considerations have much perplexed Philosophers, and have driven them into diverse thoughts to find out the reasons of them. Some observing that the dividing of a body into little parts, maketh it lesse apt to descend, then when it is in greater; have believed the whole cause of lightness and rarity to be derived from division. As for example, they

4.
The opinion of those Philosophers declared, who put rarity to consist in an aqual division of a Body into little parts.

find that lead cut into little pieces, will not go down so fast in water, as when it is in bulk: and it may be reduced into so small atomes, that it will for some space Twimme upon the water like dust of wood.

Which assumption is proved by the great Galileus; unto whose excellent wit and admirable industry the world is beholding, not onely for his wonderfull discoveries made in the heavens, but also for his accurate and learned declaring of those very things that lie under our feet. He, about the 90. page of his first Dialogue of motion, doth clearly demonstrate how any reall medium must of necessity resist more the descent of a little piece of lead, or any other weighty matter, then it would a greater piece: and the resistance will be greater and greater, as the pieces are lesser and lesser. So that as the pieces are made lesse, they will in the same medium sink the slower; and do seem to have acquired a new nature of lightnesse by the diminution: not onely of having lesse weight in them then they had; as half an ounce is lesse then a whole ounce: but also of having in themselves a lesse proportion of weight to their bulk then they had; as a pound of cork is in regard of its magnitude lighter then a pound of lead: so as they conclude, that the thing whose continued parts are the lesser, is in its own nature the lighter and the rarer; and other things whose continued parts are greater, they be heavier and denser.

5
The former opinion rejected,
and the ground
of their error
discovered.

But this discourse reacheth not home: for by it the weight of any body being discovered by the proportion it hath to the medium in which it descendeth, it must ever suppose a body lighter then it self in which it may sink and go to the bottome. Now of that lighter body, I enquire, what maketh it be so; and you must answer by what you have concluded, that it is lighter then the other, because the parts of it are lesse, and more severed from one another: for if they be as close together, their division availeth them nothing, since things sticking fast together, do work as if they were but one, and so a pound of lead though it be filed into small dust, if it be compacted hard together, will sink as fast as if it were in one bulk.

Now then allowing the little parts to be separated, I ask, what other body filleth up the spaces between those little parts of the medium in which your heavy body descended? For if
the

the parts of water are more severd then the parts of lead, there must be some other substance to keep the parts of it asunder: let us suppose this to be aire: and I ask, Whether an equall part of aire be as heavie as so much water? or whether it be not? If you say, it is; then the compound of water and aire must be as heavie as lead; seeing that their parts one with an other are as much compacted as the parts of lead are. For there is no difference whether those bodies, whose little parts are compacted together, be of the same substance, or of divers, or whether the one be divided into smaller parts then the other, or no, (so they be of equall weights) in regard of making the whole equally heavic: as you may experience, if you mingle pin-duſt with a sand of equall weight, though it be beaten into farre smaller divisions then the pin-duſt, and put them in a bag together.

But if you say, that aire is not so heavy as water; it must be, because every part of aire hath again its parts more severd by some other body, then the parts of water are severd by aire. And then I make the same instance of that body which severd the parts of aire. And so at the last (since there cannot actually be an infinite processe of bodies one lighter then another) you must come to one, whose little parts filling the pores and spaces between the parts of the others, have no spaces in themselves to be filled up.

But as soon as you acknowledge such a body to be lighter and rarer then all the rest, you contradict and destroy all you said before. For by reason of its having no pores, it followeth by your rule, that the little parts of it must be as heavy, if not heavier, then the little parts of the same bignesse of that bodie whose pores it filleth; and consequently it is proved by the experience we alledged of pin-duſt mingled with sand, that the little parts of it cannot by their mingling with the parts of the body in which it is immediately contained, make that lighter then it would be if these little parts were not mingled with it. Nor would both their parts mingled with the body which immediately containeth them, make that body lighter. And so proceeding on in the same sort through all the mingled bodies, till you come to the last, that is immediately mingled with water; you will make water nothing the lighter, for being mingled with all these; and by consequence it should be as heavie and as dense as lead.

Now that which deceived the authours of this opinion, was that they had not a right intelligence of the causes which made little parts of bodies (naturally heavie) descend slowly, in regard of the velocitie of greater parts of the same bodies descending: the doctrine of which we intend to deliver hereafter.

6.
The opinion of those Philosophers related, who put rarity to consist in the mixtion of vacuity among bodies.

Others therefore perceiving this rule to fall short, have endeavoured to piece it out by the mixtion of vacuities among bodies; believing it is that which maketh one rarer than another. Which mixtion they do not put alwayes immediate to the main body they consider: but if it have other rarer and lighter bodies mingled with it, they conceive this mixtion immediate onely to the rarest, or lightest. As for example; a crysell being lighter and consequently rarer than a diamond, they will not say that there is more vacuity in a crysell than in a diamond; but that the pores of a crysell are greater, and that consequently there is more aire in a crysell to fill the pores of it, then is in a diamond; and the vacuities are in the aire, which abounding in a crysell, more than in a diamond, maketh that lighter and rarer than this, by the more vacuities that are in the greater Quantitie of aire which is mingled with it.

But against this supposition, a powerfull adversary is urged: for Aristotle, in his 4. book of Physicks, hath demonstrated that there can be no motion in vacuity. It is true, they endeavour to evade his demonstration (as not reaching home to their supposition) by acknowledging it to be an evident one in such a vacuity as he there speaketh of; which he supposed to be so great a one that a bodie may swimme in it as in an ocean, and not touch or be near any other body: whereas this opinion excludeth all such vast inanie, and admitteth no vacuities but so little ones as no body whatsoever can come unto but will be bigger then they; and consequently, must on some side or other touch the corporeall parts which those vacuities divide; for they are the separations of the least parts, that are, or can be, actually divided from one another: which parts must of necessitie touch one another on some side; or else they could not hang together to compose one substance; and therefore, the dividing vacuities, must be lesse then the divided parts. And thus, no bodie will ever be in danger of floating up and down without touching any thing: which is the difficultie that Aristotle chiefly impugneth. I

I confesse I should be very glad that this supposition might serve our turn, and save the Phenomena that appear among bodies, through their varietie of Raritie and Denfitie: which if it might be, then would I straight go on to the inquiring after what followed out of this ground, as Astronomers (to use our former similitude) do calculate the future appearances of the celestjall bodies out of those motions and orbes they assigne unto the heavens. For as this apprehension of vacuities in bodies is very easie and intelligible: so the other (which I conceive to be the truth of the case) is exceedingly abstracted, and one of the most difficult points in all the Metaphysicks: and therefore I would (if it were possible) avoid touching upon it in this discourse, which I desire should be as plain and easie, and as much removed from scholastick terms, as may be.

But indeed, the inconveniences that follow out of this supposition of vacuities, are so great, as it is impossible by any means to slide them over. As for example; let us borrow of Galileus the proportion of weight between water and aire. He sheweth us how the one is 400. times heavier then the other. And Marinus Ghetaldus teacheth us that gold is 19. times heavier then water: so that gold must be 7600 times heavier then aire. Now then considering that nothing in a body can weigh, but the solid parts of it; it followeth, that the proportion of the parts of gold in a sphere of an inch diameter, is to the parts of aire, of a like dimension as 7600 is to one. Therefore in aire it self the vacuities that are supposed in it, will be to the solid parts of it in the same proportion as 7600 to one. Indeed, the proportion of difference will be greater: for even in gold many vacuities must be admitted, as appeareth by the heating of it which sheweth that in every the least part it is exceeding porous. But according to this rate, without pressing the inconvenience any further; the aire will by this reckoning appear to be like a net, whose holes and distances, are to the lines and thrids, in the proportion of 7600 to one; and so, would be lyable to have little parts of its body swimme in those greater vacuities; contrary to what they strive to avoid. Which would be exceedingly more, if we found on the one side any bodies heavier and denser then gold, & that were so solide as to exclude all vacuities; & on the other side should ballance them with such

bodies

7.

The opinion of vacuities refuted.

Dialog. 1. del. Mozim. pag. 81.

Archimed. Promot.

bodies as are lighter and rarer then aire; as fire is, and as some will have the *æther* to be. But already the disproportion is so great, and the vacuity so strangely exceedeth the body in which it is, as were too great an absurdity to be admitted.

And besides, it would destroy all motion of small bodies in the aire, if it be true (as Aristotle hath demonstrated in the fourth book of his Physicks) that motion cannot be made but among bodies, and not *in vacuo*.

Again, if rarity were made by vacuity, rare bodies could not be gathered together, without losing their rarity and becoming dense. The contrary of which, we learn by constant experience; as when the smith and glassmender drive their white and fury fires, (as they term them;) when aire pierceth most in the sharp wind; and generally we see that more of the same kind of rare bodies, in lesse place, worketh most efficaciously according to the nature that resulteth out of that degree of rarity. Which argueth, that every little part is as rare as it was before (for else it would lose the virtue of working according to that nature;) but that by their being crowded together, they exclude all other bodies that before did mediate between the little parts of their main body; and so, more parts being gotten together in the same place then formerly there were, they work more forcibly.

Thirdly, if such vacuities were the cause of rarity, it would follow, that fluide bodies being rarer then solid ones, they would be of themselves standing, like nets or cobwebs: whereas contrariwise, we see their natures are to run together, and to fill up every little creek and corner: which effect, following out of the very nature of the things themselves; must needs exclude vacuities out of that nature.

And lastly, if it be true (as we have shewed in the last Chapter) that there are no actuall parts in Quantity; it followeth of necessity, that all Quantity must of it self be one; as Metaphysicks teach us: and then, no distance can be admitted between one Quantity and another.

And truly, if I understand Aristotle right, he hath perfectly demonstrated, that no vacuity is possible in nature; neither great nor little: and consequently, the whole machine raised upon that supposition, must be ruinous. His argument is to this purpose:

purpose: What is nothing, cannot have parts: but vacuum is nothing (because as the adversaries conceive it, vacuum is the want of a corporeall substance in an enclosing body, within whose sides nothing is, whereas a certain body might be contained within them, as if in a pail or bowl of a gallon, there were neither milk, nor water, nor aire, nor any other body whatsoever) therefore, vacuum cannot have parts. Yet those who admit it do put it expressly for a space; which doth essentially include parts. And thus they put two contradictories, nothing and parts, that is, parts and no parts; or something and nothing; in the same proposition. And this, I conceive to be absolutely unavoidable.

For these reasons therefore, I must entreat my readers favour, that he will allow me to touch upon metaphysicks a little more then I desire or intended: but it shall be no otherwise, then as is said of the dogs by the river Nilus side; who being thirsty, lap hastily of the water, onely to serve their necessity as they run along the shore. Thus then; remembering how we determined that Quantity is Divisibility: it followeth, that if besides Quantity there be a substance or thing which is divisible; that thing, if it be condistinguished from its Quantity or Divisibility, must of it self be indivisible: or (to speak more properly) it must be, not divisible. Put then such substance to be capable of the Quantity of the whole world or universe; and consequently, you put it of it self indifferent to all, and to any part of Quantity: for in it, by reason of the negation of Divisibility, there is no variety of parts, whereof one should be the subject of one part of Quantity, or another of another; or that one should be a capacity of more, another of lesse.

This then being so, we have the ground of more or lesse proportion between substance and quantity: for if the whole quantity of the universe be put into it, the proportion of Quantity to the capacity of that substance, will be greater then if but half that quantity were imbibed in the same substance. And because proportion changeth on both sides by the single change of onely one side: it followeth, that in the latter, the proportion of that substance to its Quantity, is greater; and that in the former, it is lesse; howbeit the substance in it self be indivisible.

8.

Rarity and Density consist in the severall proportions, which Quantity hath to its substance.

What we have said thus in abstract, will sink more easily in to us if we apply it to some particular bodies here among us, in which we see a difference of Rarity and Density; as to aire, water, gold, or the like; and examine if the effects that happen to them, do follow out of this disproportion between substance and Quantity. For example, let us conceive that all the Quantity of the world were in one uniform substance, then the whole universe would be in one and the same degree of Rarity and Density: let that degree, be the degree of water; it will then follow; that in what part soever there happeneth to be a change from this degree, that part will not have that proportion of quantity to its substance, which the quantity of the whole world had to the presupposed uniform substance. But if it happeneth to have the degree of rarity which is in the aire, it will then have more quantity in proportion to its substance, then would be due unto it according to the presupposed proportion of the quantity of the universe to the foresaid uniform substance; which in this case is as it were the standard to try all other proportions by. And contrariwise, if it happeneth to have the degree of Density which is found in earth or in gold; then it will have lesse quantity in proportion to its substance, then would be due unto it according to the foresaid proportion, or common standard.

Now to proceed from hence, with examining the effects which result out of this compounding of Quantity with substance, we may first consider, that the definitions which Aristotle hath given us of Rarity and Density, are the same we drive at: he telleth us, that that body is rare whose quantity is more, and its substance lesse; that, contrariwise dense, where the substance is more and the quantity lesse. Now if we look into the proprieties of the bodies we have named, or of any others; we shall see them all follow clearly out of these definitions. For first, that one is more diffused, another more compacted; such diffusion and compaction seem to be the very natures of Rarity and Density, supposing them to be such as we have defined them to be; seeing that, substance is more diffused by having more parts, or by being in more parts; and is more compacted by the contrary. And then, that rare bodies are more divisible then dense ones, you see is coincident into the same conceit with their diffusion and compaction. And from hence again it followeth,

loweth, that they are more easily divided in great, and likewise, that they are by the force of naturall Agents divisible into lesser parts : for both these (that is, facility of being divided, and easie divisibility into lesser parts) are contained in being more divisible; or in more enjoying the effect of quantity, which is divisibility. From this again followeth, that in rare bodies there is lesse resistance to the motion of another body through it, then in dense ones ; and therefore a like force passeth more easily through the one, then through the other. Again ; rare bodies are more penetrative and active then dense ones; because being (by their overproportion of quantity) easily divisible into small parts, they can run into every little pore, and so incorporate themselves better into other bodies, then more dense ones can. Light bodies likewise must be rarer, because most divisible, if other circumstances concur equally.

Thus you see decyphered unto your hand, the first division of bodies flowing from Quantity as it is ordained to substance for the composition of a bodie : for since the definition of a body is, *A thing which hath parts*; and quantity is that, *by which it hath parts* ; and the first propriety of quantity is, *to be bigger or lesse*; and consequently the first differences of having parts, are to have bigger or lesse, more or fewer; what division of a body can be more simple, more plain, or more immediate, then to divide it by its *Quantity* as making it have bigger or lesse, more or fewer parts in proportion to its substance?

Neither can I justly be blamed for touching thus on Metaphysicks, to explicate the nature of these two kinds of bodies; for Metaphysicks being the science above Physicks, it belongeth unto her to declare the principles of Physicks : of which, these we have now in hand, are the very first step. But much more, if we consider that the composition of quantity with substance, is purely Metaphysicall ; we must necessarily allow the inquiry into the nature of Rarity and Density, to be wholly Metaphysicall; seeing that the essence of Rarity and Density standeth in the proportion of quantity to substance; if we believe Aristotle, (the greatest master that ever was, of finding out definitions and notions) and trust to the uncontrollable reasons we have brought in the precedent discourse.

This explication of Rarity and Density, by the composition
of

All must admit
in Physicall bo-
dies, a Meta-
physicall com-
position.

of substance with quantitie, may peradventure give little satisfacti-
on unto such as are not used to raise their thoughts above
Physicall and naturall speculations; who are apt to conceive
there is no other composition or resolution, but such as our sen-
ses shew us in compounding and dividing of bodies according
to quantative parts. Now this obligeth us to shew that such a
kind of composition and division as this, must necessarily be al-
lowed of, even in that course of doctrine which seems most con-
trary to ours. To which purpose, let us suppose that the positi-
on of Democritus or of Epicurus is true; to wit, that the origi-
nall composition of all bodies, is out of very little ones of vari-
ous figures; all of them indivisible, not Mathematically, but
Physically: and that this infinite number of indivisibles, doth
float in an immense ocean of vacuum or imaginary space. In
this position, let any man who conceiveth their grounds may
be maintained, explicate how one of these little bodies is mo-
ved. For taking two parts of vacuum, in which this body suc-
cessively is; it is cleare, that really, and not onely in my under-
standing, it is a difference in the said body to be now here now
there: wherefore when the body is gone thither, the notion of
being here is no more in the body; and consequently is divided
from the body. And therefore when the body was here, there
was a composition between the body and its being here; which
seeing it cannot be betwixt two parts of Quantity, must of ne-
cessity be such a kind of composition, as we put between quan-
tity and substance. And certainly, let men wrack their brains
never so much, they will never be able to shew how motion is
made, without some such composition and division, upon what
grounds soever they proceed.

And if then they tell us, that they understand not how there
can be a divisibility between substance and quantity; we may
reply, that to such a divisibility two things are required; first,
that the notions of substance and quantity be different; second-
ly, that the one of them may be changed without the other.
As for the first, it is most evident we make an absolute distincti-
on between their two notions; both when we say that Socrates
was bigger a man then a boy; and when we conceive that
milk or water whiles it boyleth, or wine whiles it worketh,
so as they run over the vessels they are in, are greater, and
possesse

possesse more place then when they were cool and quiet, and filled not the vessel to the brim. For howsoever witty explications may seem to evade, that the same thing is now greater now lesser; yet it cannot be avoided, but that ordinary men who look not into Philosophy, do both conceive it to be so, and in their familiar discourse expresse it so; which they could not do, if they had not different notions of the substance, and of the quantity of the thing they speak of. And though we had no such evidences, the very names and definitions of them would put it beyond strife: all men calling substance, a thing; quantitie, bignesse: and referring a thing to *Being*; as who would say, that which is: but bignesse to some other of like nature, unto which it is compared; as, that it is half as big, twice as big, or the like.

This then being unavoidable, that the notions are distinguished; there remaineth no difficulty but onely in the second, namely that the one may be changed, and the other not. Which reason and demonstration do convince, as we have shewed. Wherefore if any shall yet further reply, that they do not understand how such change is made; we shall answer, by asking: them whether they know how the change of being sometimes here sometimes there is made by locall motion in vacuum, without a change in the body moved. Which question if they cannot satisfie, they must either deny that there is any locall motion in vacuum; or else admit a change in quantity without a change in substance; for this latter is as evidently true, as they suppose the former to be; though the manner how they are effected be alike obscure in both, and the reason of the obscurity the same in both.

With which we will conclude the present Chapter; adding onely this note: That if all Physicall things and naturall changes do proceed out of the constitution of rare and dense bodies in this manner as we do put them, (as the work we have in hand intendeth to shew) then, so manifold effects will so convince the truth of this doctrine which we have declared, that there can remain no doubt of it: neither can there be any of the divisibility of quantity from substance; without which this doctrine cannot consist. For it cannot be understood; how there is a greater proportion of quantitie then of substance;

stance; or contrariwise, of substance then of quantity; if there be not a reall divisibility between quantity and substance. And much lesse can it be conceived, that the same thing hath at one time a greater proportion of quantity, and at another time a lesse; if the greater or lesser proportion be not separable from it; that is, if there be not a divisibility betwixt it and substance, as well as there are different notions of them. Which to prove by the proper principles belonging to this matter, would require us to make a greater inrode into the very bowels of Metaphysicks, and to take a larger circuit than is fitting either for the subject, or for the intended brevity of this Treatise.

CHAP. IIII.

Of the foure first qualities: and of the foure Elements.

I.

The notions of density and rarity have a latitude capable of infinite variety.

THE subject of our discourse hitherto hath been three simple notions; Quantity, Rarity, and Density. Now it shall be to enquire if by compounding these with gravitie or weight (which is one of the specieses of Quantity above mentioned, and of which I shall speak at large hereafter) we may beget any further qualities, and so produce the foure first bodies called Elements. In imitation of Logicians, who by compounding such propositions as of themselves are evident to mans nature as soon as they are proposed, do bring forth new knowledges: which thrids they still entermix and weave together, till they grow into a fair piece. And thus the sciences they so much labour for, and that have so great an extent, do result out of few and simple notions in their beginnings.

But before we fall to mingling and comparing them together, I think it will not be amisse to set down and determine what kind of things we mean by rare, and what by dense; to the end that when the names are agreed upon, we may slip into no error by mistaking them. So then although there be severall considerations, in regard of which, rarity and density may be differently attributed to bodies: yet because mans discerning them, to be able to discourse accordingly of them, is the principall respect for which their denominations are to be allotted them:

we may with reason call those things dense; wherein a man findeth a sensible difficultie to part them; and those rare, where the resistance is imperceptible.

And unto these two notions of rarity and density, we must allow a great latitude, farre from consisting in an indivisible state; for seeing that rarefaction maketh a lesser bodie equall to a bigger; and that all inequality betwixt two bodies, hath the conditions of a bodie; it followeth that the excesse of one bodie over an other, consisteth of infinite parts into which it might be divided: and consequently, that what is rarified, passeth as many degrees as the inequality or excesse hath parts. And the same law being in condensation, both dense and rare things must be acknowledged to be capable of infinite varietie, and diversity of states in regard of more and lesse in the same kind.

These things being premised; and calling to mind that it is the nature of density to make the parts of a dense thing compact, and stick together, and be hardly divisible; and on the contrary side, that it is the nature of rarity, to diffuse and extend a rare thing, and to prepare and approach it to division, according to the proportion of the degree of rarity which it hath; and that weight doth abound where there is excesse of densitie, and is very little or none in excesse of rarity: we may now begin in our imagination to put these qualities into the scales one against another, to see what effects they produce in bodies. And first, let us weigh gravity against densitie or sticking together of parts: which sticking or compactednesse being naturall to densitie, requireth some excesse of gravitie in proportion to the density, or some other outward violence, to break it. If then in a dense body the gravity overcome the density, and do make the parts of it break asunder, it will draw them downwards towards the center that gravity tendeth unto, and will never let them rest till they come thither, unlesse some impediment meet them by the way and stop their journey: so that such a body will, as near as possibly it can, lie in a perfect sphericall figure in respect of the center; and the parts of it will be changed and altered, and thrust on any side that is the ready way thither; so that by the force of gravity working upon it, it will run as farre as it meeteth with nothing to hinder it from

2.

How moistnesse and drynesse are begotten in dense bodies.

attaining this spherick superficies. Wherefore such bodies, for the most part, have no settled outside of their own; but do receive their figure and limits from such lets as hinder them from attaining to that sphericknesse they aim at.

Now Aristotle (whose definitions, are in these matters generally received, as fully expressing the notions of mankind) telleth us, and our own experience confirmeth it, that we use to call those things *moist*, which run in such sort as we have here set down; and that we term those things *dry*, which have a consistence within themselves; and which to enjoy a determinate figure, do not require the stop or hinderance of another body to limit and circle them in: which will be the nature of those that have a greater proportion of density in respect of their gravity.

And thus, out of the comparison of densitie with weight, we have found two more qualities then we yet had met withall, namely wetnesse and drynesse. For although a body be dense, (which of its own nature, singly considered, would preserve the continuity of its parts, as making the body hardly divisible; whereby it would be dry) yet if the gravity that worketh upon it, be in proportion greater then the densitie; it will sever the parts of it, and make them run to the center, and so become fluide and moist: though not in the eminentest degree that may be of fluidity and moisture; by reason that if the like overproportion of gravity happen in a rare body, it will there more powerfully work its effect, then it can in a dense body; because a rare body will more easily obey, and yield to the gravitie that mastereth it, then a dense one will; and consequently, will be more fluide and moist then it.

Now on the other side, in weighing rarity against gravity; if it happen that the rarity overcome the gravity, then the gravity will not change the figure of a body so proportioned, but what figure it hath from its proper naturall causes, the same will still remain with it: and consequently, such a body will have terms of its own, and will not require an ambient body to limit, and circle it in: which nature, we call dry.

But if the proportion of the gravity be the greater and do overcome the rarity; then, by how much the rarity is greater, so much the more will the gravity force it, to apply it self equally

3.
How moistnesse
and drynesse
are begotten in
rare bodies.

ly and on all sides to the center : and such a body will the more easily receive its figure from another, and will be lesse able to consist of it self : which properties, we attribute to wetnesse or moisture. So that it appeareth, how the qualities of wet and dry, which first we found in things that were dense, are also common to that nature of bodies, which we term rare.

And thus, by our first inquiry after what kind of bodies do result out of the compounding of rarity and densitie with gravity, we discover foure different sorts : some dense ones that are dry, and others likewise dense that are moist : then again, some rare ones that are likewise moist, & other rare ones that are dry.

But we must not rest here : let us proceed a little further, to search what other properties these foure kinds of bodies will have ; which we shall best discover, if we apply them severally to some other compounded body (of which nature, are all those we converse with or see) and then consider the effects which these do work upon it. To beginne with that, which we said is so excessively rare that gravity hath no power over it. If we look upon the multitude of little parts it may be divided into, whereof every one will subsist by it self (for we have already proved it dry) and then suppose them to be moved with force and strength against the body we apply them to: it must necessarily follow, that they will forcibly get into the porousnesse of it, and passe with violence between part and part, and of necessity separate the parts of that thing one from another ; as a knife or wedge doth a solide substance, by having their thinnest parts pressed into it : so that if in the compounded thing, some parts be more weighty, others more light, (as of necessitie there must be) the heaviest will all fall lowest, the lightest will fly uppermost, and those which are of a mean nature between the two extremes, will remain in middle. In summe, by this action of an extreme rare body upon a compounded one, all the parts of one kind that were in the compounded one, will be gathered into one place ; and those of divers kinds into divers places : which is the notion whereby Aristotle hath expressed the nature of heat ; and is an effect, which daily experience in burning and boyling, teacheth us to proceed from heat. And therefore we cannot doubt, but that such extreme rare bodies are as well hot as dry.

4.

Heat is a property of rare bodies, and cold of dense ones.

On the other side, if a dense thing be applyed to a compound, it will (because it is weighty) presse it together : and if that application be continued on all sides, so that no part of the body that is pressed be free from the siege of the dense body that presseth it, it will form it into a narrower room, and keep in the parts of it, not permitting any of them to slip out. So that what things soever it findeth within its power to master, be they light or heavy, or of what contrary natures soever, it compresseth them as much as it can, and draweth them into a lesse compasse, and holdeth them strongly together, making them stick fast to one another. Which effect, Aristotle took for the proper notion of cold; & therefore gave for definition of the nature of it, *that it gathereth things of divers natures* : and experience sheweth us in freeing, and all great coolings, that this effect proceedeth from cold.

5.

Of the two
dense bodies,
the lesse dense
is more cold:
but of the two
rare ones, the
lesse rare is
lesse hot.

But if we examine which of the two sorts of dense bodies (the fluide or the consistant) is most efficacious in this operation; we shall find that the lesse dense one is more capable of being applyed round about the body it shall besiege; and therefore will stop closer every little hole of it, and will more easily send subtile parts into every little vein of it; and by consequence, shrink it up together and coagulate, and constringe it more strongly, then a body can that is extremely dense; which by reason of its great density, and the stubbornesse of its parts, cannot so easily bend and plie them to work this effect. And therefore, a body that is moderately dense is colder then another that is so in excesse; seeing that cold is an active or working power, and that which is lesse dense doth excell in working.

On the contrary side, rare bodies being hot, because their subtile parts environing a compounded body will sink into the pores of it, and to their power separate its parts; it followeth that those wherein the gravity overcometh the rariry, are lesse hot then such others as are in the extremity, and highest excesse of rarity: both, because the former are not able to pierce so little parts of the resisting dense body, as extreme rare ones are; and likewise, because they more easily take ply by the obstacle of the solide ones they meet with, then these do.

So that out of this discourse we gather, that of such bodies that differ precisely by the proportion of Rarity and Density; those which are extremely rare, are in the excess of heat, and are dry withall: that weighty rare bodies are extremely humid, and meanly hot: that fluide dense bodies are moist, though not in such excess as rare ones that are so; but are coldest of any: and lastly, that extreme dense bodies are lesse cold then fluide dense ones, and that they are dry.

But whether the extreme dense bodies be more or lesse dry then such as are extremely rare, remaineth yet to be decided. Which we shall easily do, if we but reflect that it is density which maketh a thing hard to be devided, and that rarity maketh it easie: for a facility to yield unto division, is nothing else but a plyablenesse in the thing that is to be divided, whereby it easily receiveth the figure, which the thing that divideth it doth cast it into. Now this plyablenesse belongeth more to rare then to dense things: and accordingly, we see fire bend more easily, by the concameration of an oven, then a stone can be reduced into due figure by hewing. And therefore, since drynesse is a quality that maketh those bodies wherein it reigneth, to conserve themselves in their own figure and limits, and to resist the receiving of any from another body; it is manifest that those are driest, wherein these effects are most seen; which is, in dense bodies: and consequently, excess of drynesse must be allotted unto them, to keep company with their moderate coldnesse.

Thus we see that the number of Elements assigned by Aristotle is truly and exactly determined by him; and that there can be neither more nor lesse of them; and that their qualities are rightly allotted to them: which to settle more firmly in our minds, it will not be misse-spent time to summe up in short the effect of what we have hitherto said to bring us unto this conclusion. First, we shewed that a body is made, and constituted a body by quantity. Next, that the first division of bodies is into rare and dense ones; as differing onely by having more and lesse quantity. And lastly, that the conjunction of gravity with these two, breedeth two other sorts of combinations: each of which is also twofold; the first sort, concerning rarity; out of which ariseth one extremely hot and moderately dry, and another

6.

The extreme dense body is more dry, then the extreme rare one.

7.

There are but foure simple bodies: and these are rightly named Elements.

other extremely humide and moderately hot : the second sort, concerning density; out of which, is produced one that is extremely cold and moderately wet, and another extremely dry and moderately cold. And these are the combinations whereby are constituted fire, aire, water, and earth.

So that we have thus, the proper notions of the foure Elements; and have both them and their qualities driven up and resolved into their most simple principles: which are, the notions of *Quantity*, and of the two most simple differences of quantative things, *Rarity* and *Density*. Beyond which, mans wit cannot penetrate; nor can his wishes aim at more in this particular: seeing he hath attained to the knowledge of what they are, and of what maketh them be so, and that it is impossible they should be otherwise: and this, by the most simple and first principles, which enter into the composition of their nature. Out of which it is evident, that these foure bodies are *Elements*: since they cannot be resolved into any others, by way of physicall composition; themselves being constituted by the most simple differences of a body. And again, all other bodies whatsoever must of necessity be resolved into them, for the same reason; because no bodies can be exempt from the first differences of a body. Since then, we mean by the name of an Element, *a body not composed of any former bodies, and of which all other bodies are composed*, we may rest satisfied that these are rightly so named.

8.

The Authour doth not determine whether every element doth comprehend under its name one onely lowest species, or many: nor whether any of them be found pure.

But whether every one of these foure elements, do comprehend under its name one onely lowest species or many (as, whether there be one onely species of fire, or severall; and the like of the rest) we intend not here to determine. Yet we note, that there is a great latitude in every kind; seeing that, *Rarity* and *Density* (as we have said before) are as divisible as quantity. Which latitudes, in the bodies we converse withall, are so limited that what maketh it self and other things be seen (as being accompanied by light) is called fire. What admitteth the illuminative action of fire, and is not seen, is called aire. What admitteth the same action and is seen (in the rank of Elements) is called water. And what through the density of it admitteth not that action, but absolutely reflecteth it, is called earth.

And

And out of all we said of these four Elements, it is manifest there cannot be a fifth: as is to be seen at large in every Aristotelian Philosopher that writeth of this matter. I am not ignorant that there are sundry objections used to be made, both against these notions of the first qualities, and against the division of the Elements: but because they, and their solutions, are to be found in every ordinary Philosopher; and that they be not of any great difficulty; and that the handling them, is too particular for the designe of this discourse, and would make it too prolix; I referre the Reader to seek them, for his satisfaction, in those authours that treat physicks professedly, and have delivered a compleat body of Philosophy.

And I will end this Chapter with advertising him (lest I should be misunderstood) that though my disquisition here hath pitched upon the four bodies of fire, aire, water, and earth; yet it is not my intention to affirm, that those which we ordinary call so, and do fall dayly within our use, are such as I have here expressed them: or that these Philosophicall ones (which arise purely out of the combination of the first qualities) have their residence or consistence in great bulks, in any places of the world, be they never so remote: as fire, in the hollow of the moons orb; water, in the bottome of the sea; aire, above the clouds; and earth below the mines. But these notions are onely to serve for certain Idea's of Elements; by which, the four named bodies, and the compounds of them, may be tryed and receive their doom of more or lesse pure and approaching to the nature from whence they have their denomination. And yet I will not denie, but that such perfect Elements may be found in some very little quantities, in mixed bodies: and the greatest abundance of them, in these four known bodies that we call in ordinary practise, by the names of the pure ones: for they are least compounded, and approach most to the simpleness of the Elements. But to determine absolutely their existence, or not existence, either in bulk or in little parts; dependeth of the manner of action among bodies: which as yet we have not meddled with.

CHAP. V.

Of the operations of the Elements in generall. And of their activities compared with one another.

I.
The first operation of the Elements is division, out of which resulteth locall motion.

HAVING by our former discourse inquired out what degrees, and proportions of rarity and density compounded with gravity, are necessary for the production of the Elements, & first qualities; whose combinations, frame the Elements: our next consideration in that orderly progresse we have proposed unto our selves in this treatise (wherein our aim is, to follow successively the steps, which nature hath printed out unto us) will be to examine the operations of the Elements, by which they work upon one another. To which end, let us propose to our selves a rare and a dense body encountering one another by the impulse of some exterior agent. In this case, it is evident, that since rarity implyeth a greater proportion of quantity, and quantity is nothing but divisibility, rare bodies must needs be more divisible then dense ones: and consequently, when two such bodies are pressed one against another; the rare body not being able to resist division so strongly, as the dense one is; and being not permitted to retire back, by reason of the extern violence impelling it against the dense body; it followeth, that the parts of the rare body must be severed, to let the dense one come between them: and so the rare body becometh divided, and the dense body the divider. And by this we see that the notions of divider and divisible do immediately follow rare and dense bodies; and do so much the more properly agree unto them, as they exceed in the qualities of Rarity and Density.

Likewise, we are to observe in our case, that the dense or dividing body must necessarily cut and enter further and further into the rare or divided body; and so the sides of it be joynd successively to new and new parts of the rare body that giveth way unto it, and forsake others it parteth from. Now the rare body being in a determinate situation of the universe, (which we call *being in a place*, and is a necessary condition belonging to all particular bodies) and the dense body coming to be within the rare body, whereas formerly it was not so: it followeth, that it loseth the place it had, and gaineth another. This effect, is that which we call locall motion.

And

And thus we see, by explicating the manner of this action, that locall motion is nothing else but the change of that respect or relation, which the body moved hath to the rest of the universe, following out of Division: and the name of locall motion, formally signifieth onely the mutation of a respect to other extrinsecall bodies, subsequent to that division. And this is so evident and agreeable to the notions that all mankind (who, as we have said, is judge and master of language) naturally frameth of place, as I wonder much why any will labour to give other artificiaall and intricate doctrine of this that in it self is so plain and clear. What need is there to introduce an imaginari space (or with Joannes Grammaticus, a subsistent quantity) that must run through all the world; and then entayl to every body an aïery entity, an unconceivable mood, an unintelligible Ubi, that by an intrinsecall relation to such a part of the imaginary space, must thereunto pin and fasten the body it is in? It must needs be a ruinous Philosophy that is grounded upon such a contradiction, as is the allotting of parts unto that, which the authours themselves (upon the matter) acknowledge to be merely nothing; and upon so weak a shift (to deliver them from the inconveniencies that in their course of doctrine other circumstances bring them unto) as is the voluntary creating of new imaginary Entities in things, without any ground in nature for them. Learned men should expresse the advantage and subtilty of their wits, by penetrating further into nature, then the vulgar; not by vexing and wresting it from its own course. They should refine and carry higher, not contradict and destroy the notions of mankind, in those things that it is the competent judge of: as it undoubtedly is of those primary notions which Aristotle hath ranked under ten heads: which (as we have touched before) every body can conceive in grosse: and the work of scholars is to explicate them in particular; and not to make the vulgar believe they are mistaken, in framing those apprehensions that nature taught them.

2.
What place it;
both notionally
and really.

Out of that which hath been hitherto resolved it is manifest, that place really, and abstracting from the operation of the understanding, is nothing else but the inward superficies of a body that compasseth and immediately containeth another. Which ordina-

ordinarily being of a rare body that doth not shew it self unto us (namely, the aire) is for the most part unknown by us. But because nothing can make impression upon our mind, and cause us to give it a name otherwise then by being known: therefore our understanding to make a complete notion, must adde something else to this fleeting and unremarkable superficies that may bring it unto our acquaintance. And for this end we may consider further, that as this superficies hath in it self, so the body enclosed in it gaineth a certain determinate respect unto the stable and immoveable bodies that environ it. As for example, we understand such a tree to be in such a place by having such and such respects to such a hill near it, or to such a house that standeth by it, or to such a river that runneth under it, or to such an immoveable point of the heaven that from the sunnes rising in the equinox is called East, and such like. To which purpose, it importeth not whether these that we call immoveable bodies and points be truly so, or do but seem so to mankind. For man talking of things according to the notions he frameth of them in his mind (speech being nothing else but an expression to another man, of the images he hath within himself) and his notions being made according to the seeming of the things, he must needs make the same notions, whether the things be truly so in themselves, or but seem to be so, when that seeming or appearance is alwayes constantly the same.

3.
Locall motion
is that division
whereby a body
changeneth its
place.

Now then when one body dividing another, getteth a new immediate clothing; and consequently new respects to the stable and immoveable bodies (or seeming such) that environ it; we do vary in our selves the notion we first had of that thing; conceiving it now accompanied with other circumstances and other respects then formerly it had. Which notion we expresse by saying, it hath changed its place, and is now no longer where it was at the first. And this change of place we call *Locall motion*: to wit, the departing of a body from that hollow superficies which inclosed it; and its changing unto an other, whereby it gaineth new respects to those parts of the world that have, or in some sort may seem to have, immobility and fixed stableness. So as hence it is evident that the substance of locall motion consisteth in division; and that the alteration of Locality followeth division; in such sort as becoming like or unlike of one wall

to another, followeth the action whereby one of them becometh white.

And therefore in nature we are not to seek for any entity or speciall cause of applying the moved body to a place as place, (which is but a respect consequent to the effect of division) but onely to consider what reall and physycall action uniteth it to that other body, which is called its place, and truly serveth for that effect. And consequently, they who think they have discovered a notable subtilty by bringing in an Entitie to unite a body to its place, have strained beyond their strength, and have grasped but a shadow. which will appear yet more evident, if they but mark well how nothing is divisible but what of it self (abstracting from division) is one. For the nature of division is *the making of many*; which implyeth, that what is to be divided must of necessity be not *many* before it be divided. Now quantity being the subject of division, it is evident that purely of it self and without any force or adjoynd helps, it must needs be one, wheresoever some outward agent doth not introduce multiplicity upon it. And whensoever other things work upon quantity as quantity, it is not the nature and power of their operation to produce unity in it and make it one; for it is already one: but contrariwise, the immediate necessary effect that floweth from them in this case, is to make one quantity many, according to the circumstances that accompany the divider, and that which is to be divided. And therefore, although we may seek causes why some one thing sticketh faster together then some other, yet to ask absolutely why a body sticketh together, were prejudiciall to the nature of quantity; whose essence is to have parts sticking together, or rather to have such unity, as without it all divisibility must be excluded.

Out of which discourse it followeth, that in locall motion we are to look onely for a cause or power to divide, but not for any to unite. For the very nature of quantity uniteth any two parts that are indistant from one another, without needing any other cement to glew them together: as we see the parts of water and all liquid substances, do presently unite themselves to other parts of like bodies when they meet with them, and to solid bodies if they chance to be next unto them. And therefore it is vain to trouble our heads with Unions and imagina-

4.
The nature of quantity of it self is sufficient to unite a body to its place.

ry Moods to unite a body to the place it is in, when their own nature maketh them one as soon as they are immediate to each other. And accordingly if when we see a boull move, we would examine the causes of that motion, we must consider the quantity of aire or water it maketh to break from the parts next unto it, to give place unto it self; and not speculate upon an intrinsecall relation from the body to a certain part of the imaginary space they will have to run through all things. And by ballancing that quantity of aire or water which it divideth, we may arrive to make an estimate of what force the boull needeth to have for its motion.

5. All operations amongst bodies, are either local motion, or such as follow out of local motion.

Thus having declared that the locality of motion is but an extrinsecall denomination, and no reality in the thing moved; we may now cast an eye upon a vast consequence that may be deduced out of what we have hitherto said. For if we consider the nature of a body, that is. that a body is a body by quantity; and that the formall notion of quantity is nothing else but divisibility; and that the adequate act of divisibility is division: it is evident there can be no other operation upon quantity, nor (by consequence) among bodies, but must either be such division as we have here explicated, or what must necessarily follow out of such division. And division (as we have even now explicated) being local motion; it is evident, that all operations among bodies are either local motion, or such as follow out of local motion. Which conclusion, howsoever unexpected, and may at the first hearing appear a Paradox, will neverthelesse by the ensuing work receive such evidence as it cannot be doubted of; and that not onely by force of argumentation and by necessitie of notions (as is already deduced) but also by experience, and by declaration of particulars as they shall occur.

6. Earth compared to water in activity.

But now to apply what we have said to our proposed subject: it is obvious to every man, that seeing the divider is the agent in division and in local motion; and that dense bodies are by their nature dividers; the earth must in that regard be the most active among the elements, since it is the most dense of them all. But this seemeth to be against the common judgement of all the searchers of nature, who unanimously agree that fire is the most active element. As also it seemeth to impugne what we
our

our selves have determin'd, when we said, there were two active qualities, heat and cold, whereof the first was in its greatest excessse in fire, and the latter in water.

To reconcile these, we are to consider that the action of cold in its greatest height is compos'd of two parts; the one is a kind of pressing, and the other is penetration which requireth applicability. Of which two the former ariseth out of density, but the latter out of moderation of density, as I have declared in the precedent Chapter. Wherefore the former will exceed more in earth, though the whole be more eminent in water. For though considering onely the force of moving (which is a more simple and abstracted notion, then the determination and particularization of the Elements, and is precedent to it) therein earth hath a precedency over water: yet taking the action as it is determin'd to be the action of a particular Element, and as it concurrerth to the composition or dissolution of mixed bodies; in that consideration (which is the chief work of Elements, and requireth an intime application of the Agents) water hath the principality and excessse over earth.

S. 6.

As for fire it is more active then either of them; as it will appear clearly if we consider, how when fire is apply'd to fewell, and the violence of blowing is added to its own motion; it incorporateth it self with the fewell, and in a small time converteth a great part of it into its own nature, and shattereth the rest into smoke and ashes. All which proceedeth from the exceeding smalness and drynessse of the parts of fire; which being moved with violence against the fewell, and thronging in multitudes upon it; they easily pierce the porous substance of it, like so many extreme sharp needles.

7.

The manner whereby fire getteth into fewell, proveth that it exceedeth earth in activity.

And that the force of fire is as great and greater then of earth, we may gather out of our former discourse; where having resolv'd that density is the virtue by which a body is moved and doth cut the medium; and again considering that celerity of motion, is a kind of densitie, (as we shall by and by declare) it is evident, that since blowing must of necessity presse violently and with a rapid motion, the parts of fire against the fewell, and so condense them exceedingly there, (both by their celerity, and by bringing very many parts together there;) it must needs.

needs also give them activity and virtue to pierce the body they are beaten against.

Now, that celerity is a kind of density, will appear by comparing their natures. For if we consider that a dense body may be dilated so as to possess and fill the place of a rare body that exceeded it in bignesse; and by that dilatation, may be divided into as many and as great parts as the rare body was divisible into; we may conceive that the substance of those parts, was by a secret power of nature folded up in that little extension in which it was before. And even so, if we reflect upon two rivers of equall channels and depths, whereof the one goeth swifter then the other; and determine a certain length of each channell, and a common measure of time: we shall see that in the same measure of time, there passeth a greater bulk of water in the designed part of the channel of the swifter stream, then in the designed part of the slower, though those parts be equall.

Neither doth it import, that in velocity we take a part of time, whereas in density it seemeth that an instant is sufficient; and consequently, there would be no proportion between them. For knowing Philosophers do all agree that there are no instants in time, and that the apprehension of them proceedeth merely from the manner of our understanding. And as for parts in time, there cannot be assumed any so little, in which the comparison is not true: and so in this regard, it is absolutely good.

And if the Reader have difficulty at the disparity of the things which are pressed together in density and in celerity; for that in density there is onely substance, and in celerity there is also quantity, crowded up with the substance; he will soon receive satisfaction, when he shall consider that this disparity is to the advantage of what we say, and maketh the nature of density more perfect in celerity, and consequently more powerful in fire then in earth. Besides, if there were no disparity, it would not be a distinct species of density, but the very same.

8.

The same is proved by the manner, where by fire cometh out of fewell and worketh upon other bodies.

By what we have spoken above, it appeareth how fire getteth into fewell; now let us consider how it cometh out: for the activity of that fierce body will not let it lie still and rest, as long as it hath so many enemies round about it to rouse it up. We see then that as soon as it hath incorporated it self with the fewell,

fewell,

fewell and is grown master of it by introducing into it so many of its own parts, (like so many souldiers, into an enemies town) they break out again on every side with as much violence as they came in. For by reason of the former resistance of the fewell; their continuall streaming of new parts upon it, and one overtaking another there where their journey was stopped, (all which is encreased by the blowing) doth so exceedingly condense them into a narrower room then their nature affecteth, that as soon as they get liberty, and grow masters of the fewell, (which at the first was their prison) they enlarge their place, and consequently come out and flie abroad; ever ayiming right forwards from the point where they begin their journey : for the violence wherewith they seek to extend themselves into a larger room, when they have liberty to do so; will admit no motion but the shortest, which is, by a straight line.

So that if in our phantasie, we frame an image of a round body all of fire; we must withall presently conceive, that the flame proceeding from it, would diffuse it self every way indifferently in straight lines; in such sort, that the source serving for the center, there would be round about it an huge sphere of fire and of light; unlesse some accidentall and extern cause should determine its motion more to one part then to another. Which compasse, because it is round, and hath the figure of a sphere, is by Philosophers termed the sphere of its activity.

So that it is evident, that the most simple and primary motion of fire, is a flux in a direct line from the center of it, to its circumference, taking the fewell for its center: as also, that when, it is beaten against a harder body, it may be able to destroy it, although that body be in its own nature more dense then fire. For the body against which it presseth, either hath pores, or hath none, (as, the Elements have none:) if it hath pores; then the fire, by reason of the violent motion of the impellent, driveth out the little bodies which fill up those pores, and succeeding in their room, and being multiplyed there, causeth those effects which in our discourse of the Elements we assigned to heat. But if it have no pores; it will be either rare or dense: if it be rare; then, in case that the force of the impellent be
greater

greater then the resistance of the rare body, it will force the fire to divide the rare body. But if it be dense; as, some atome of earth; then, though at the first it cannot divide it; yet by length of time and by continuall beating upon it, it may come to wear off some part of it, the force of the impellent by little and little bending the atome of the earth, by driving a continuall stream of a lesser part of fire, against some determinate part of the atome. By which word *Atome*, no body will imagine we intend to expresse a perfect indivisible, but onely, the least sort of naturall bodies.

CHAP. VI.

Of Light: what it is.

I.
In what sense
the Authour
rejecteth qua-
lities.

HAVING said thus much of fire; the near relation that is between it and light, inviteth us in the next place to bend our eyes to that which useth to dazell theirs who look unwarily upon it. Certainly, as among all the sensible qualities, it is the principall; so among all corporeall things, it seemeth to aim rightest at a spirituall nature, and to come nearest unto it. And by some hath been judged to be spirituall; if our eyes be capable to see spirits. No meaner man then Aristotle leadeth the dance to hold light a quality, and mainly to deny it any bodily subsistence. And there hath followed him no fewer, then almost all the world ever since. And the question importeth no lesse, then the whole doctrine of qualities; for admit light to be a body, and hardly any man will hold up his hand in defence of any other quality: but if it be a quality; then all others come in by parity and for company.

But before we go any further, it will not be amisse to expresse what we mean when we reject qualities; and how, in some sense, we are content to admit them. According to that description that Philosophers ordinarily do make of them, (and especially the modern) we can by no means give way unto them. I confesse ingenuously, I understand not what they mean by them; and I confident, that neither do they. For the very notion, that their first words seem to expresse of them, they contradict again, before they make an end of describing what they are. They will have them to be reall

Entities

Entities or Things, distinct from the bodies they accompany: and yet, they deny them a subsistence or self-being; saying they do but inhere in their subject, which supporteth them; or which is all one, that their being is a dependence of a subject.

If they will reflect upon what they say, and make their thoughts and their words agree; they will find, that the first part of their description maketh them compleat substances; which afterwards, in words they flatly deny: and it is impossible to reconcile these two meanings. A reall Entity or thing must necessarily have an *Existence* or *Being* of its own: which they allow them. And whatsoever hath so, becometh a substance: for it subsisteth by its own Existence; or (to say plainer) is what it is by its own Being; and needeth not the existence of another thing to give it a *Being*. And then presently to say that it doth not subsist of it self; or that it requireth the subsistence of a substance, to make it *Be*; is a pure contradiction to the former.

This ariseth from a wrong notion they make to themselves of substance, existence and subsistence: and from their not consulting sufficiently with their own thoughts, as well as studying in books. They meet there with different terms; by help of which, they keep themselves from contradiction in words, but not in effect. If the terms were rightly conceived, and notions duely fitted to them, (which requireth deep meditation upon the things themselves, and a brain free from all inclination to siding, or affection to opinions for the authours sakes, before they be well understood and examined) many of those disputes would fall to the ground, in which oftentimes both sides lose themselves, and the question, before they come to an end. They are in the dark before they are aware: and then they make a noise, onely with terms; which like too heavy weapons that they cannot weild, do carry their strokes beyond their aim. Of such nature are the qualites and moods, that some modern Philosophers have so subtilised upon. And in that sense, we utterly denie them: which being a question appertaining to Metaphysicks, it belongeth not to our present purpose to ingage our selves further in it.

But, as they are ordinarily understood in common conversation,

In what sense
the Authour
doth admit of
qualities.

sation, we allow them. And our work is but to explicate and shew the particulars in retail, of what men naturally speak in grosse. For that serveth their turn to know what one another meaneth: whereas, it belongeth onely unto a Philosopher, to examine the causes of things. Others are content with the effects: and they speak truly and properly when they designe them. As for example: when they say that fire burneth by a quality of heat that it hath, or that a deye is square by the quality of a cubicall figure that is in it; they speak as they should do. But if others will take occasion upon this, to let their understanding give a *Being* unto these qualities, distinct from the substances in which they conceive them; there they misse. If we consider the same man hungry, or thirsty, or weary, or sleepy, or standing, or sitting: the understanding presently maketh within it self reall things of sleep, hunger, thirst, wearinesse, standing, and sitting. Whereas indeed, they are but different affections or situations of the same body. And therefore we must beware of applying these notions of our mind, to the things as they are in themselves: as much as we must, of conceiving those parts to be actually in a continued quantity, whereof we can frame actually distinct notions in our understanding. But as, when ordinary men say, that a yard containeth three feet; it is true in this sense, that three feet may be made of it; but that whiles it is a yard, it is but one quantity or thing, and not three things: so, they who make profession to examine rigorously the meaning of words, must explicate in what sense it is true that heat and figure (our former examples) are qualities: for such we grant them to be; and in no wise do contradict the common manner of speech; which entereth not into the Philosophicall nature of them.

We say then, that qualities are nothing else but the proprieties, or particularities wherein one thing differeth from another. And therefore Logicians, call substantiall differences, substantiall qualities: and say, they are predicated in *Quale quid*. But the Predicament of *Quality* is ordered by Aristotle to conclude in it those differences of things, which are neither substantiall nor quantitative, and yet are intrinsecall and absolute. And so that which the understanding calleth heat, and maketh a
notion

notion of, distinct from the notion of the fire from whence it issueth to burn the wood that is near it; is nothing else, in the fire, but the very substance of it in such a degree of rarity; or a continuall stream of parts issuing out of the main stock of the same fire, that entreth into the wood, and by the rarity of it maketh its way through every little part, and divideth them. All which actions are comprised by the understanding under one notion of burning: and the power, (which is fire it self) to do these actions, under one notion of the quality of heat: though burning in effect, and explicated Philosophically, be nothing else but the continuance of those material motions we have even now described. In like manner, the cubicall figure of a deye, is nothing else but the very body of the deye it self, limited by other bodies from being extended beyond those dimensions it hath: and so the quality of figure or squarenesse, which in common speech is said to be in it; is truly, the substance it self, under such a consideration as is expressed by that word.

But to come to our question, upon the decision of which dependeth the fate of all the fictitious Entities which in the schools are termed qualities. The cheif motives that perswade light to be one of those; may, to my best remembrance, be reduced to five severall heads. The first is, that it illuminateth the aire in an instant, and therefore cannot be a body: for a body requireth succession of time to move in: whereas, this seemeth to spread it self over the whole hemisphere in an instant; for as farre as the sunne is distant from us, he no sooner raiseth his head above our horizon, but his darts are in our face: and generally, no imagination can be framed, of any motion it hath in its dilatation.

The next is; that whereas no body can admit another into its place, without being removed away it self, to leave that room unto the advenient one; neverthelesse, plain experience sheweth us dayly, that two lights may be in the same place; and the first is so farre from going away at the coming of the second, that the bringing in of a second candle, and setting it near the first, increaseth the light in the room; which diminisheth again when the second is removed away. And by the same reason; if light were a body, it should drive away the aire

3.
Five arguments
proposed to
prove that light
is not a body.

(which is likewise a body) wheresoever it is admitted: for within the whole sphere of the irradiation of it, there is no point wherein one may set their eye, but light is found. And therefore, if it were a body there would be no room for aire in that place which light taketh up. And likewise, we see that it penetrateth all solid bodies, (and particularly glasse,) as experience sheweth, in wood, stone, metals, and any other body whatsoever, if it be made thinne enough.

The third argument, why light cannot be a body, is, that if it were so, it can be none other but fire, which is the subtilest, and most rarified of all bodies whatsoever. But if it be fire, then it cannot be without heat: and consequently, a man could not feel cold in a sunne-shining day. The contrary of which is apparent all winter long; whose brightest dayes oftentimes prove the coldest. And Galileus with divers others since, did use from the sunne to gather light in a kind of stone that is found in Italy (which is therefore by them called, *la calamita della luce*) and yet no heat appeared in it. A glow-worm will give light to read by, but not to warm you any whit at all. And it is said, that diamonds and carbuncles will shine like fire in the greatest darks; yet no man ever complained of being served by them as the foolish Satyre was by kissing of a burning coal. On the contray side; if one consider how great heats may be made without any light at all, how can one be perswaded that light & heat should be the same thing, or indeed any whit of kin?

The fourth motive to induce us to believe that light cannot be a body, is the sudden extinction of it, when any solid body cometh between the fountain of it, and the place where he sendeth his beams. What becometh of that great expansion of light that shined all about, when a cloud interposeth it self between the body of the sunne and the streams that come from it? Or when it leaveth our horizon to light the other world? His head is no sooner out of our sight; but at the instant all his beams are vanished. If that which filleth so vast a room were a body, something would become of it: it would at least be changed to some other substance; and some reliques would be left of it; as when ashes remain of burned bodies: for nature admitteth not the annihilation of any thing.

And in the last place; we may conceive that if light were a body,

dy, it would be shaken by the winds, and by the motion of the aire; and we should see it quaver in all blustering weather. Therefore, summing up all we have said; it seemeth most improbable, and indeed wholly impossible, that light should be a body; and consequently, must have his place among qualities.

But on the other side; before we apply our selves to answer these objections, let us make a short survey of those inducements, that prevail with us to believe light a body, notwithstanding so forcible oppositions. I admit so farre of the third argument, as to allow light to be fire: for indeed it cannot be imagined to be any thing else; all properties agreeing so fully between them. But withall I must adde; that it is not fire in every form, or fire joyned with every substance, that expresseth it self by light; but it is fire extremely dilated, and without mixture of any other grosse body. Let me hold a piece of linen or paper close by the flame of a candle, and by little and little, remove it further and further off; and me thinks my very eyes tell me, that there is upon the paper some part of that which I see in the candle; and that it groweth still lesse and lesse like as I remove the paper further from it: so that, if I would believe my sense, I should believe it as very a body upon the paper, as in the candle; though enfeebled, by the laxity of the channel in which it floweth.

And this seemeth to be strengthened, by the consideration of the adversaries position: for if it were a quality; then, seeing it hath no contrary to destroy or stop it, it should still produce an equall to it self, without end or growing feeble, whensoever it meeteth with a subject capable to entertain it, as aire is.

The better to apprehend how much this faint resemblance of flame upon the paper, maketh for our purpose; let us turn the leaf, and imagine in our thoughts, after what fashion that fire which is in the flame of a little candle, would appear unto us, if it were dilated and stretched out to the utmost extent that excess of rarity can bring it unto. Suppose that so much flame, as would fill a cone of two inches height and half an inch diameter should suffer so great an expansion as to replenish with his light body a large chamber: and then, what can we imagine it would seem to be? How would the con-

4.

The two first reasons to prove light to be a body are, the resemblance it hath with fire; and because if it were a quality, it would alwayes produce an equall to it self.

5.

The third reason; because if we imagine to our selves the substance of fire to be rarified, it will have the same appearances which light hath.

tinuall driving it into a thinner substance, as it streameth in a perpetuall flood from the flame; seem to play upon the paper? And then judge whether it be likely to be a body or no, when our discourse suggesteth unto us, that if it be a body, those very appearances must follow, which our eyes give us evidence are so in effect. If gold beaten into so airy a thinnesse as we see guilders use, doth remain still gold notwithstanding the wonderfull expansion of it: why shall we not allow, that fire dilated to his utmost period, shall still remain fire; though extremely rarified beyond what it was?

6.

The fourth reason, from the manner of the generation and corruption of light, which agreeth with &c.

We know that fire is the rarest and the subtilest substance that nature hath made among bodies; and we know likewise, that it is ingendered by the destroying and feeding upon some other more grosse body: let us then calculate, when the oyl, or tallow, or wax of a candle, or the bulk of a faggot or billet, is dilated and rarified to the degree of fire; how vast a place must it take up?

To this let us adde what Aristotle teacheth us; that fire is not like a standing pool, which continueth full with the same water; and as it hath no wast, so hath it no supply: but it is a fluent and brooklike current. Which also we may learn, out of the perpetuall nutriment it requireth: for a new part of fewell, being converted into a new part of fire (as we may observe, in the little atomes of oyl, or melted wax, that continually ascend apace up the week of a burning candle or lamp) of necessity the former must be gone to make room for the latter; and so, a new part of the river is continually flowing.

Now then, this perpetuall flux of fire, being made of a grosse body that so rarified will take up such a vast room; if it die not at the instant of its birth, but have some time to subsist (be it never so short,) it must needs runne some distance from the fountain whence it springeth. Which if it do; you need not wonder, that there should be so great an extent of fire as is requisite to fill all that space which light replenisheth; nor that it should be still supplied with new, as fast as the cold of the aire killeth it: for considering that flame is a much grosser substance then pure fire, (by reason of the mixture with it, of that viscous oily matter, which being drawn out of the wood and candle, serveth for fewell to the fire, and

is by little and little converted into it;) and withall reflecting upon the nature and motion of fire, (which is, to dilate it self extremely, and to fly all about from the center to the circumference;) you cannot choose but conceive, that the pure fire struggling to break away from the oily fewell (which is still turning into new fire) doth at length see his wings from that birdlime, and then flyeth abroad with extreme swiftnesse, and swelleth & dilateth it self to a huge bulk, now that it hath gotten liberty; and so filleth a vast room; but remaineth still fire till it die: which it no sooner doth, but it is still supplied with new streams of it, that are continually strained, & as it were squeezed, out of the thick flame, which did imprison it, and kept it within it; till growing fuller of fire then it could contain (by reason of the continuall attenuating the oily parts of it, and converting them into fire) it giveth liberty unto those parts of fire, that are next the superficies, to fly whither their nature will carry them.

And thus, discourse would inform a blind man (after he hath well reflected on the nature of fire) how it must needs fill a mighty extent of place; though it have but a narrow beginning at the springhead of it: and that there, by reason of the condensation of it, and mixture with a grosser body, it must needs burn other bodies; but that when it is freed from such mixture, and suffereth an extreme expansion, it cannot have force to burn, but may have means to expresse it self to be there present by some operation of it upon some body that is refined and subtilized enough to perceive it. And this operation a seeing man will tell you is done upon his eyes, (whose fitnessse to receive impression from so subtile an Agent, Anatomistes will teach you.) And I remember, how a blind schoolmaster that I kept in my house to teach my children, (who had extreme subtile spirits, and a great tendernesse through his whole body; and met with few distractions, to hinder him from observing any impression, never so nicely made upon him) used often to tell me, that he felt it very preceptibly in severall parts of his body; but especially in his brain.

But to settle us more firmly in the persuasion of light his being a body (and consequently fire;) let us consider that the properties of a body, are perpetually incident to light; look what rules a ball will keep in its rebounds; the same, doth light in

7.
The fifth reason; because such properties belong to light as agree onely unto bodies.

its reflexions : and the same demonstration doth alike convince the one and the other. Besides, light is broken like a body; as when it is snapped in pieces by a tougher body. It is gathered together into a little room by looking or burning glasses; as water is, by ordering the gutters of a house so as to bring into one cistern all that raineth dispersedly upon the whole roof. It is severed and dispersed by other glasses; and is to be wrought upon, and cast hither and thither at pleasure; all by the rule of other bodies. And what is done in light, the same will likewise be done in heat, in cold, in wind, and in sound. And the very same instruments that are made for light, will work their effects in all these others, if they be duly managed.

So that certainly, were it not for the authority of Aristotle and of his learned followers that presseth us on the one side; and for the seemingness of those reasons we have already mentioned, which perswadeth us on the other side; our very eyes would carry us by stream into this consent, that light is no other thing but the nature and substance of fire, spread farre and wide, and freed from the mixture of all other grosse bodies. Which will appear yet more evident in the solutions of the oppositions we have brought against our own opinion: for in them there will occurre other arguments of no lesse importance to prove this verity, then these we have already proposed.

CHAP. VII.

Two objections answered against light being fire; with a more ample proof of its being such.

I.
That all light is
hot and apt to
heat.

HAVING then said thus much to perswade us of the corporeity of this subtile thing, that so queintly playeth with our eyes: we will in the next place examine those objections that at the beginning we did set down against its being a body: and if after a through discussion of them, we find they do in truth conclude nothing of what at the first sight they bear so great a shew of; but that we shall be able perfectly to solve and enerve their force; no body will think it rashness in us to crave leave of Aristotle that we may dissent from him in a matter that he hath not looked to the bottom of; and whose opinion therein

cannot be defended from plain contradictions and impossibilities. It is true, never any one man looked so farre as he into the bowels of nature; he may be rightly termed the Genius of it; and whosoever followeth his principles in the main, cannot be led into errour: but we must not believe that he or any man else that relieth upon the strength and negotiation of his own reason, ever had a priviledge of infallibility entailed to all he said. Let us then admire him for what he hath delivered us: and where he falleth short or is weary in his search, and suffereth himself to be born down by popular opinions against his own principles (which happeneth very seldome to him) let us seek to supply and relieve him.

But to pursue our intent: We will begin with answering the third objection; which is, that if light were fire, it must heat as well as enlighten where it shineth. There is no doubt but it doth so: as is evident by the weather-glasses, and other artificiall muscull instruments (as organs and virginals that played by themselves) which Cornelius Drebbel (that admirable master of mechanicks) made to shew the king. All which depended upon the rarefaction and condensation of some subtile body, conserved in a cavitie within the bulk of the whole instrument: for assoon as the sunne shined, they would have motion and play their parts. And there is no doubt but that grew out of the rarefaction of the subtile liquor he made use of, which was dilated assoon as the aire was warmed by the sunne-beams. Of whose operation it was so sensible, that they no sooner left the horizon, but its motion ceased. And if but a cloud came between the instrument and them, the musick would presently go slower time. And the ancient miracle of Memmons statue, seemeth to be a juggling of the Ethiopian Priests made by the like invention.

But though he and they found some spirituall and refined matter, that would receive such notable impressions, from so small alterations of temper; yet it is no wonder that our grosse bodies are not sensible of them: for we cannot feel heat unlesse it be greater then that which is in our sense. And the heat there must be in proportion to the heat of our blood; which is an high degree of warmth. And therefore it is very possible

2.
The reason why our bodies for the most part do not feel the heat of pure light.

sible that an exceeding rarified fire, may cause a farre lesse impression of heat then we are able to feel. Consider how if you set pure spirit of wine on fire, and so convert it into actual flame; yet it will not burn, nor scarce warm your hand: and then can you expect that the light of a candle which filleth a great room, should burn or warm you as far as it shineth?

If you would exactly know what degree of heat, and power of burning that light hath, which (for example) shineth upon the wall in a great chamber, in the middest whereof there standeth a candle; do but calculate what overproportion of quantitie all the light in the whole room beareth to the quantity of the little flame at the top of the candle, and that is the overproportion of the force of burning which is in the candle, to the force of burning which is in so much light at the wall as in extension is equall to the flame of the candle. Which when you have considered, you will not quarrell at its not warming you at that distance; although you grant it to be fire, streaming out from the flame as from the spring that seedeth it, and extremely dilated (according to the nature of fire, when it is at liberty) by going so farre, without any other grosse body to imprison or clog it.

It is manifest, that this rule of examining the proportion of burning in so much of the light as the flame is, (by calculating the proportion of the quantity or extension of all the light in the room to the extension of the flame of the candle, and then comparing the flame of the candle to a part of light equall in extension unto it) is a good and infallible one, if we abstract from accidentall inequalities: since both the light and the flame are in a perpetuall flux; and all the light was first in the flame, which is the spring from whence it continually floweth. As in a river wherein every part runneth with a settled stream; though one place be straighter, and another broader; yet of necessitie, since all the water that is in the broad place came out of the narrow, it must follow that in equall portions of time, there is no more water where it hath the liberty of a large channell, then where the banks presse it into a narrower bed, so that there be no inequalities in the bottome.

In like manner, if in a large stove a basin of water be converted

verted into steam; that rarified water which then filleth the whole stove, is no more then what the basin contained before: and consequently, the power of moistening which is in a foots extension (for example) of the stove wherein that steam is, must be in proportion to the virtue of wetting in the foots extension of water; as the quantity of that great room which the steam filleth, is to the quantity of the water contained in the basin: for although the rarified water be not in every least part of that great place it seemeth to take up; by reason that there is aire in which it must swim; yet the power of wetting that was in the basin of water, is dilated through the whole room, by the conjunction of the myst or dew to all the sensible parts of the aire that is in the room: and consequently the power of wetting which is in any foot of that room, is in a manner as much lesse then the power of wetting which was in the foot of water, as if the water were rarified to the quantity of the whole room, and no aire were left with it.

And in the same manner it fareth with dilated fire, as it doth with dilated water: with onely this difference peradventure, that fire groweth purer and inore towards its own nature by dilatation; whereas water becometh more mixed and is carried from its nature by suffering the like effect. Yet dilated water will in proportion moysten more then dilated fire will burn; for the rarefaction of water bringeth it nearer to the nature of aire (whose chief propriety is moisture,) and the fire that accompanieth it when it raiseth it into steam, giveth it more powerfull ingression into what body it meeteth withall: whereas fire when it is very pure, and at entire liberty to stretch and spread it self as wide as the nature of it will carry it, getteth no advantage of burning by its mixture with aire: and although it gaineth force by its purity, yet by reason of its extreme rarefaction it must needs be extremely faint. But if by the help of glasses you will gather into lesse room that which is diffused into a great one; and so condense it as much as it is (for example) in the flame of a candle; then that fire or compacted light will burn much more forcibly then so much flame: for there is as much of it in quantity (excepting what is lost in the carriage of it;) and it is held in together in as little room; and it hath this advantage besides,

besides, that it is clogged with no grosse body to hinder the activity of it.

3.

The experience of burning glasses, and of foultry gloomy weather, prove light to be fire.

It seemeth to me now, that the very answering this objection doth (besides repelling the force of it) evidently prove that light is nothing but fire in his own nature, and exceedingly dilated: for if you suppose fire (for example, the flame of a candle) to be stretched out to the utmost expansion that you may well imagine such a grosse body is capable of; it is impossible it should appear and work otherwise then it doth in light, as I have shewed above. And again, we see plainly that light gathered together burneth more forcibly then any other fire whatsoever, and therefore must needs be fire.

Why then shall we not confidently conclude, that what is fire before it getteth abroad, and is fire again when it cometh together, doth likewise remain fire during all its journey? Nay, even in the journey it self we have particular testimony that it is fire: for light returning back from the earth charged with little atomes (as it doth in foultry gloomy weather) heateth much more then before; just as fire doth when it is imprisoned in a dense body.

4.

Philosophers ought not to judge of things by the rules of vulgar people.

Philosophers ought not to judge by the same rules that the common people doth. Their grosse sense is all their guide: and therefore they cannot apprehend any thing to be fire, that doth not make it self be known for such by burning them. But he that judiciously examineth the matter, and traceth the pedigree and period of it; and seeth the reason why in some circumstances it burneth, and in others it doth not; is too blame, if he suffer himself to be led by others ignorance contrary to his own reason. When they that are curious in perfumes, will have their chamber filled with a good sent in a hot season that agreeth not with burning perfumes, and therefore make some odoriferous water be blown about it by their servants mouths that are dexterous in that ministry, (as is used in Spain in the summer time;) every one that seeth it done, though on a sudden the water be lost to his eyes and touch, and is onely discernable by his nose; yet he is well satisfied that the sent which recreateth him, is the very water he saw in the glasse extremely dilated by the forcible sprouting of it out from the servants mouth, and will by little and little fall down and become again palpable

pable water as it was before ; and therefore doubteth not but it is still water whiles it hangeth in the aire divided into little atomes. Whereas one that saw not the beginning of this operation by water, nor observed how in the end it sheweth it self again in water, might the better be excused if he should not think that what he smelled were water blown about the aire, nor any substance of it self (because he neither seeth nor handleth it) but some adventitious quality he knoweth not how adhering to the aire. The like difference is between Philosophers that proceed orderly in their discourses, and others that pay themselves with terms which they understand not. The one see evidence in what they conclude ; whiles the others guesse wildly at randome.

I hope the Reader will not deem it time lost from our main drift, which we take up thus in examples and digressions : for if I be not much deceived, they serve exceedingly to illustrate the matter : which I hope I have now rendred so plain , as no man that shall have well weighed it, will expect that fire dilated into that rarified substance which mankind (who according to the different appearance of things to their sense, giveth different names unto them) calleth light , should burn like that grosser substance which from doing so they call fire ; nor doubt but that they may be the same thing more or lesse attenuated ; as leaf-gold that flyeth in the aire as light as down, is as truly gold as that in an ingot which being heavier then any other substance, falleth most forcibly unto the ground.

5.
The different names of light and fire proceed from different notions of the same substance.

What we have said of the unburning fire (which we call light) streaming from the flame of a candle, may easily be applied to all other lights deprived of sensible heat, whereof some appear with flame, others without it: of the first sort of which, are the innoxious flames that are often seen on the hair of mens heads, and horses manes, on the masts of ships, over graves, and fat marsh grounds, and the like : and of the latter sort are glow-worms, and the light-conserving stones, rotten wood, some kinds of fish and of flesh when they begin to putrifie; and some other things of the like nature.

Now to answer the second part of this objection, that we daily see great heats without any light, as well as much light

The reason
why many
times fire and
heat are depri-
ved of light.

without any heat, and therefore light and fire cannot be the same thing: you may call to mind how dense bodies are capable of great quantities of rare ones; and thereby it cometh to passe, that bodies which repugne to the dilatation of flame, may nevertheless have much fire enclosed in them. As in a stove, let the fire be never so great, yet it appeareth not outwards to the sight, although that stove warm all the rooms near it: So when many little parts of heat are imprisoned in as many little cells of grosse earthly substance, (which are like so many little stoves to them) that imprisonment will not hinder them from being very hot to the sense of feeling (which is most perceptible of dense things.) But because they are choaked with the closeness of the grosse matter wherein they are enclosed, they cannot break out into a body of flame or light, so to discover their nature: which (as we have said before) is the most unfit way for burning; for we see that light must be condensed to produce flame and fire; as flame must be to burn violently.

Having thus cleared the third objection, (as I conceive;) let us go on to the fourth; which requireth that we satisfie their inquisition, who ask what becometh of that vast body of shining light (if it be a body) that filleth all the distance between heaven and earth; and vanisheth in a moment as soon as a cloud or the moon interposeth it self between the sunne and us, or that the sunne quitteth our hemisphere? No signe at all remaineth of it after the extinction of it, as doth of all other substances, whose destruction is the birth of some new thing. Whither then is it flown? We may be perswaded that a myst is a corporeall substance, because it turneth to drops of water upon the twigs that it environeth: and so we might believe light to be fire, if after the burning of it out, we found any ashes remaining; but experlence assureth us, that after it is extinguished, it leaveth not the least vestigium behind it of having been there.

Now, before we answer this objection, we will entreat our adversary to call to mind, how we have in our solution of the former declared and proved that the light, which (for example) shineth from a candle, is no more then the flame is, from whence it springeth, the one being condensed and the other dilated; and that the flame is in a perpetuall flux of consumption

7.
What becometh
of the body of
light when it
dieth.

about the circumference, and of restauration at the center, where it sucketh in the fewell: and then we will enquire of him, what becometh of that body of flame which so continually dieth and is renewed, and leaveth no remainder behind it; as well as he doth of us, what becometh of our body of light, which in like manner is alwayes dying and alwayes springing fresh? And when he hath well considered it, he will find that one answer will serve for both.

Which is, That as the fire streameth out from the fountain of it, and groweth more subtile by its dilatation, it sinketh the more easily into those bodies it meeteth withall: the first of which and that environeth it round about, is aire. With aire then it mingleth and incorporateth it self, and by consequence with the other little bodies that are mingled with the aire: and in them it receiveth the changes which nature worketh: by which it may be turned into the other elements, if there be occasion; or be still conserved in bodies that require heat.

Upon this occasion, I remember a rare experiment that a noble man of much sincerity, and a singular friend of mine, told me he had seen: which was, That by means of glasses made in a very particular manner, and artificially placed one by another, he had seen the sun-beams gathered together, and precipitated down into a brownish or purplish red powder. There could be no fallacy in this operation: for nothing whatsoever was in the glasses when they were placed and disposed for this intent: and it must be in the hot time of the yeare, else the effect would not follow. And of this Magistry he could gather some dayes near two ounces in a day. And it was of a strange volatile nature, and would pierce and imprint his spirituall quality into gold it self (the heaviest and most fixed body we converse withall) in a very short time. If this be plainly so, without any mistaking; then mens eyes and hands may tell them what becometh of light when it dieth, if a great deal of it were swept together. But from what cause soever this experience had its effect, our reason may be satisfied with what we have said above; for I confesse, for my part, I believe the appearing body might be something that came along with the sun-beams, and was gathered by them; but not their pure substance.

Some peradventure will object those lamps, which both ancient

8.

An experiment of some who pretend, that light may be precipitated into powder.

9.
The Authours
opinion
concerning lamps
pretended to
have been
found in tombes
with inconsum-
pible lights.

cient and modern writers have reported to have been found in tombes and urns, long time before closed up from mens repair unto them to supply them with new sewell; and therefore they believe such fires to feed upon nothing; and consequently, to be inconsumptible and perpetuall. Which if they be, then our doctrine that will have light to be nothing but the body of fire perpetually flowing from its center, and perpetually dying; cannot be found: for in time such fires would necessarily spend themselves in light: although light be so subtile a substance that an exceeding little quantity of sewell may be dilated into a vast quantity of light. Yet still there would be some consumption, which how imperceptible soever in a short time, yet after a multitude of revolutions of years, it must needs discover it self.

To this I answer: That for the most part, the witnesses who testifie originally the stories of these lights, are such as a rationall man cannot expect from them that exactnesse or nicetic of observation, which is requisite for our purpose; for they are usually grosse labouring people, who as they dig the ground for other intentions, do stumble upon these lamps by chance before they are aware: and for the most part, they break them in the finding; and they imagine they see a glimpse of light, which vanisheth before they can in a manner take notice of it; and is peradventure but the glistering of the broken glasse or glazed pot, which reflecteth the outward light, as soon as by rummaging in the ground and discovering the glasse, the light striketh upon it; (in such manner as sometimes a diamond by a certain encountering of light in a dusky place, may in the first twickling of the motion, seem to sparkle like fire;) and afterwards when they shew their broken lamp, and tell their tale to some man of a pitch of wit above them, who is curious to inform himself of all the circumstances that may concern such lights; they strain their memory to answer him satisfactorily unto all his demands: and thus for his sake they perswade themselves to remember what they never saw: and he again on his side, is willing to help out the story a little. And so after a while, a very formall and particular relation is made of it. As happeneth in like sort in reporting of all strange and unusuall things; which even those that in their
nature

nature abhorre from lying are naturally apt to strain a little and fashion up in a handsome mould; and almost to perswade themselves they saw more then they did: so innate it is to every man, to desire the having of some preeminence beyond his neighbours; be it but in pretending to have seen something which they have not.

Therefore, before I engage my self in giving any particular answer to this objection of pretended inconsumpible lights, I would gladly see the effect certainly averred and undoubtedly proved: for, the testimonies which Fortunius Licetus produceth (who hath been very diligent in gathering them, and very subtile in discoursing upon them; and is the exactest Authour that hath written upon this subject) do not seem unto me to make that certainty, which is required for the establishing of a ground in Philosophy. Neverthelesse, if there be any certain experience in this particular, I should think that there might be some Art by circulation of fewell, to maintain the same light for a great company of years. But I should not easily be perswaded, that either flame or light could be made without any manner of consuming the body which serveth them for fewell.

CHAP. VIII.

An answer to three other objections formerly proposed, against light being a substance.

HAVING thus defended our selves from their objections, who would not allow light to be fire; and having satisfied their inquisition, who would know what becometh of it when it dyeth, if it be a body: we will now apply our selves to answer their difficulties, who will not let it passe for a body, because it is in the same place with an other body; as, when the sunne-beams enlighten all the aire, and when the severall lights of two distinct candles are both of them every where in the same roorn. Which is the substance of the second main objection.

This of the jussling of the aire, is easily answered thus: that the aire being a very divisible body, doth without resistance yield as much place as is requisite for light. And that light,

I.
Light is not really in every part of the room it enlighteneth, nor fill eth entirely any sensible part of it, though it seem to us to do so;

though our eyes judge it diffused every where, yet is not truly in every point or atome of aire: but to make us see it every where, it sufficeth that it be in every part of the aire which is as big as the black or sight of our eye; so that we cannot set our eye in any position where it receiveth not impressions of light. In the same manner as perfumes; which though they be so grosse bodies that they may be sensibly waisted by the wind; nevertheless, they do so fill the aire, that we can put our nose in no part of the room, where a perfume is burned, but we shall smell it. And the like is of mists; as also of the sprouted water to make a perfume, which we mentioned above.

But because pure discourses, in such small thrids as these, do but weakly bind such readers as are not accustomed unto them; and that I would (if it be possible) render this Treatise intelligible to every ratioll man, how ever little versed in scholastick learning (among whom I expect it will have a fairer passage, then among those that are already deeply imbued with other principles;) let us try if we can herein inform our selves by our sense, and bring our eyes for witnesse of what we say. He then that is desirous to satisfie himself in this particular, may put himself in a dark room, through which the sunne sendeth his beams by a cranie or little hole in the wall; and he will discover a multitude of little atomes flying about in that little stream of light; which his eye cannot discern when he is environed on all sides with a full light. Then let him examine whether or no there be light in the midst of those little bodies: and his owne reason will easily tell him, that if those bodies were as perspicuous as the aire, they would not reflect upon our eyes the beames by which we see them. And therefore he will boldly conclude, that at the least such parts of them as reflect light unto us, do not admit it, nor let it sink into them. Then let him consider the multitude of them; and the little distance betwixt one another; and how nevertheless they hinder not our sight; but we have it free to discover all objects beyond them, in what position soever we place our eye: and when he thus perceiveth that these opacous bodies, which are every where, do not hinder the eye from judging light to have an equall plenary diffusion through the whole place that it irradiateth; he can have no difficulty to allow aire, (that is diaphanous,

phanous, and more subtile far then they, and consequently, divisible into lesser atomes, and having lesser pores, giveth lesse scope unto our eyes to misse light, then they do) to be every where mingled with light, though we see nothing but light, and cannot discern any breach or division of it.

Especially, when he shall adde unto this consideration; that the subtile body which thus filleth the aire, is the most visible thing in the world; and that, whereby all other things are seen: and that the aire which it minglith it selfe with, is not at all visible, by reason of the extreme diaphaneity of it, and easie reception of the light into every pore of it without any resistance or reflection: and that such is the nature of light, as it easily drowneth an obscure body, if it be not too big: and not onely such, but even other light bodies; for so we know as well the fixed starres as the planets are concealed from our sight, by nearnesse to the sunne; neither the lightnesse of the one, nor the bignesse of the other, prevailing against the darkning of an exuperant light: and we have daily experience of the same in very pure chrystall glasses, and in very clear water; which though we cannot discern by our sight if they be in certain positions; neverthelesse by experience we find that they reflect much light: and consequently have great store of opacous parts: and then he cannot choose but conclude, that it is impossible but light should appear at it doth, to be every where, and to be one continued thing; though his discourse withall assure him it is every where mingled with aire.

And this very answer I think will draw with it by consequence, the solution of the other part of the same objection; which is, of many lights joyning in the same place; and the same is likewise concerning the images of colours every where crossing one another without hinderance. But to raise this contemplation a strain higher; let us consider how light being the most rare of all known bodies, is of its own nature (by reason of the divisibility that followeth rarity) divisible into lesser parts then any other; and particularly then flame; which being mixed with smoke and other corpulency, falleth very short of light. And this, to the proportion in which it is more rare then the body it is compared unto. Now a great Mathematician having devised how to measure the rarefaction of gunne-pow-

2.

The least sensible point of a diaphanous body, hath room sufficient to contain both aire and light, together with a multitude of beams issuing from severall lights, without penetrating one another.

Wilhebrord Snell

der into flame, found the diameter 50. times encreased; and so concluded, that the body of the flame was in proportion to the body of the gunne-powder it was made of, as 125000. is to one. Wherefore by the immediately proceeding consequence, we find that 125000. parts of flame may be couched in the room of one least part of gunne-powder, and peradventure many more, considering how porous a body gunne-powder is. Which being admitted, it is evident that although light were as grosse as the flame of gunne-powder, and gunne-powder were as solide as gold; yet there might passe 125000. rayes of light, in the space wherein one least part of gunne-powder might be contained; which space would be absolutely invisible unto us, and be contained many times in the bignesse of the sight of a mans eye. Out of which we may gather what an infinity of objects may seem unto us to crosse themselves in the same indivisible place, and yet may have room sufficient for every one to passe his way, without hindering his fellow. Wherefore, seeing that one single light could not send rayes enough to fill every little space of aire that is capable of light, (and the lesse, the further it is from the flame) it is obvious enough to conceive, how in the space where the aire is, there is capacity for the rayes of many candles.

Which being well summed up, will take away the great admiration how the beams of light, though they be corporall, can in such great multitudes without hindering one another, enter into bodies and come to our eye: and will shew that it is the narrowness of our capacities, and not the defect of nature, which maketh these difficulties seem so great; for she hath sufficiently provided for all these subtile operations of fire; as also for the entrance of it into glasse, and into all other solide bodies that are diaphanous (upon which was grounded the last instance the second objection pressed :) for all such bodies being constituted by the operation of fire (which is alwayes in motion) there must needs be wayes left for it both to enter in, and to evaporate out. And this is most evident in glasse which being wrought by an extreme violent fire and swelling with it, as water and other things do by the mixture of fire; must necessarily have great store of fire in it self whiles it is boyling; as we see by its being red hot. And hence it is, that the workmen

are forced to let it cool by degrees in such relentings of fire, as they call their nealing heats, lest it should shiver in pieces by a violent succeeding of aire in the room of the fire; for that being of greater parts then the fire, would strain the pores of the glasse too suddenly, and break it all in pieces to get ingression: whereas in those nealing heats the aire being rarer, lesser parts of it succeed to the fire, and leisurely stretch the pores without hurt. And therefore we need not wonder that light passeth so easily through glasse; and much lesse, that it getteth through other bodies; seeing the experience of Alchymists doth assure us, that it is hard to find any other body so impenetrable as glasse.

But now to come to the answer of the first, and in appearance most powerfull, objection against the corporeity of light; which urgeth that his motion is performed in an instant, and therefore cannot belong to what is materiall and clothed with quantity. We will endeavour to shew how unable the sense is to judge of sundry sorts of motions of Bodies, and how grossely it is mistaken in them. And then, when it shall appear that the motion of light must necessarily be harder to be observed then those others: I conceive, all that is raised against our opinion by so incompetent a judge, will fall flat to the ground.

First then, let me put the Reader in mind, how if ever he marked children when they play with fire-sticks, they move and whirl them round so fast, that the motion will close their eyes, and represent an entire circle of fire unto them: and were it somewhat distant, in a dark night, that one played so with a lighted torch, it would appear a constant wheel of fire without any discerning of motion in it. And then, let him consider how slow a motion that is in respect of what it is possible a body may participate of: and he may safely conclude, that it is no wonder though the motion of light be not descried, and that indeed no argument can be made from thence, to prove that light is not a body.

But let us examine this consideration a little further, and compare it to the motion of the earth or heavens: let the appearing circle of the fire, be some three foot diameter, and the

3.
That light doth not enlighten any room in an instant; and that the great celerity of its motion doth make it imperceptible to our senses

time of one entire circulation of it, be the sixtieth part of a minute; of which minutes, there are 60. in an hour; so that in a whole day, there will be but 86400. of those parts of time. Now the diameter of the wheel of fire being but of three foot, the whole quantity of space that it moveth in that atome of time will be at the most 10. foot; which is three paces and a foot: of which parts, there are near eleven millions in the compasse of the earth: so that if the earth be moved round in 24. hours, it must go near 130. times as fast as the boyes stick doth, which by its swift motion deceiveth our eye. But if we allow the sunne, the moon, and the fixed starres to move; how extreme swift must their flight be, and how imperceptible would their motion be in such a compasse as our sight would reach unto? And this being certain, that whether the earth or they do move, the appearances to us are the same; it is evident, that as now they cannot be perceived to move (as peradventure they do not;) so it would be the very same in shew to us, although they did move. If the sunne were near us, and galloped at that rate; surely we could not distinguish between the beginning and ending of his race: but there would appear one permanent line of light from East to West, without any motion at all: as the torch seemeth to make, with so much a slower motion, one permanent immoveable wheel of fire.

But contrary to this effect, we see that the sunne and starres by onely being removed further from our eyes, do cosen our sight so grossely that we cannot discern them to be moved at all. One would imagine that so rapide and swift a motion, should be perceived in some sort or other, (which, whether it be in the earth, or in them, is all one to this purpose.) Either we should see them change their places whiles we look upon them, as arrows and birds do when they fly in the aire: or else, they should make a stream of light bigger then themselves, as the torch doth. But none of all this happeneth: let us gaze upon them so long and so attentively that our eyes be dazeled with looking, and all that while they seem to stand immovable: and our eyes can give us no account of their journey till it be ended. They discern it not whiles it is in doing:

so

so that if we consult with no better counsellour then them, we may wonder to see that body at night setting in the West, which in the morning we beheld rising in the East.

But that which seemeth to be yet more strange, is, that these bodies move crosse us, and neverthelesse are not perceived to have any motion at all. Consider then how much easier it is for a thing that moveth towards us, to be with us before we are aware. A nimble fencer will put in a thrust so quick, that the foil will be in your bosome, when you thought it a yard off; because in the same moment you saw his point so farre distant, and could not discern it to move towards you, till you felt the rude salutation it gave you. If then you will compare the body of light with these others that thus deceive us in regard of motion; you must needs agree it is much rashnesse to conclude it hath no motion, because we cannot discern the succession of. Consider that it is the subtillest of all the bodies that God hath made. Examine the paths of it, which for the smallnesse of their thrids, and the extreme divisibility of them, and their pliant application of themselves to whatsoever hath pores, are almost without resistance: Calculate the strange multiplication of it, by a perpetuall momentary renovation of its streams. And cast with your self; with what extreme force it springeth out and flyeth abroad. And on the other side, reflect how all these things are directly opposite and contrary in those other great bodies, whose motion neverthelesse appeareth not unto us till it be done and past. And when you have well weighed all this; you must needs grant that they who in this case guide themselves merely by what appeareth unto their eyes, are ill judgers of what they have not well examined.

But peradventure some who cannot all of a sudden be warned from what their sense hath so long sed them with; may ask yet further, How it chanceth that we have no effects of this motion? It sheweth not it self in the aire, coming to us as farre off. It stayeth not a thought, or slackneth his speed in flying so vast a space as is from the sunne to us. In fine, there is no discovery of it.

4.
The reason why the motion of light, is not discerned coming towards us; and that there is some realtity in it.

But if Galileus his conception be well grounded ; that lighting giveth us an incling of its motion, beginning from a little and encreasing to a greater ; or if Monsieur des Cartes his opinion that it goeth slower in refraction, be true : we shall not need to study long for an answer. But in Galileus his experience, it may be the breaking of the cloud which receiveth that succession of motion which we see : and no slownesse that light can acquire by the resistance of the refracting body, can be so great as to make that difference of lines which Monsieur Des Cartes most ingeniously (though I much doubt not truly) hath applyed to yield the reason of refraction : as will appear in our further discourse.

Therefore, these being uncertain ; we will, to shew the unreasonableness of this question, suppose there may be some observable tardity in the motion of light ; and then ask of them, how we should arrive to perceive it ? What sense should we employ in this discovery ? It is true, we are satisfied that sound taketh up time in coming to our eares : but it is, because our eyes are nimbler then they, and can perceive a good way distant the carpenters ax falling upon the timber that he heweth, or the fire flashing out of the canon, before they heare any newes of them : but shut your eyes ; or inquire of a blind man ; and then neither you nor he can tell whither those sounds fill your eares at the very instant they were begotten, or have spent some time in their journey to you. Thus then our eyes instruct our eares. But is there any sense quicker then the sight ? or means to know speedier then by our eyes ? Or can they see light, or any thing else ; untill it be with them ? We may then assuredly conclude, that its motion is not to be discerned as it cometh upon us ; nor it self to be perceived, till its beams are in our eyes.

But if there were any means to discover its motion, surely it must be in some medium, through which it must struggle to get, as fire doth through iron ; which increasing there by degrees, at last (when it is red hot) sendeth beams of light quite through the plate that at the first refused them passage. And it maketh to this purpose, that the light-conserving stones which are gathered in Italy, must be set in the sunne for some while before they retain light : and the light will appear in them
when

when they are brought back into the dark, greater or lesser (untill they come to their utmost period) according as they have been longer or a lesser while in the sunne. And our eyes the longer they remain in the light, the more dazeled they are if they be suddenly passed into the dark. And a curious experimenter did affirm, that the likenesse of any object (but particularly he had often observed it of an iron grate) if it be strongly inlightned will appear to another, in the eye of him that looketh strongly and steadily upon it till he be dazeled by it; even after he shall have turned his eyes from it. And the wheel of fire could never be made appear unto our eye by the whirling of the firestick we even now spoke of; unlesse the impression made by the fire from one place, did remain in the eye a while after the fire was gone from the place whence it sent that ray. Whence it is evident, that light, and the pictures of objects, do require time to settle and to unsettle in a subject. If then light maketh a greater impression with time, why should we doubt but the first cometh also in time; were our sense so nimble as to perceive it?

But then it may be objected, that the sunne would never be truly in that place in which unto our eyes it appeareth to be: because that, it being seen by means of the light which issueth from it; if that light required time to move in, the sunne (whose motion is so swift) would be removed from the place where the light left it, before it could be with us to give tidings of him. To this I answer, allowing that peradventure it may be so. Who knoweth the contrary? Or, what inconvenience would follow, if it be admitted? Indeed, how can it be otherwise? In refraction, we are sure it is so: and therefore at no time but when the sunne is perpendicularly over our heads, we can be certain of the contrary although it should send its light to us in an instant. Unlesse happely the truth of the case should be, that the sunne doth not move about us; but we turn to his light: and then, the objection also loseth its aim.

But the more we presse the quicknesse of light; the more we engage our selves in the difficulty why light doth not shatter the aire in peeces, as likewise all solid bodies whatsoever: for the masters of naturall Philofophy do tell us, that a softer thing
with

5.

The planets are not certainly ever in that place where they appear to be.

6.

The reason why light being a body, doth not by its motion shatter other bodies into peeces.

with a great velocity, is as powerfull in effect when it giveth a blow, as a harder thing going slowly. And accordingly experience teacheth us, that a tallow candle shot in a gun will go through a board or kill a man. Wherefore light having such an infinite celerity, should also have an unresistable force, to pierce and shatter, not onely the aire, but even the hardest bodies that are. Peradventure some may think it reasonable to grant the consequence (in due circumstances) since experience teacheth us, that the congregation of a little light by a glasse, will set very solid bodies on fire, and will melt metals in a very short space; which sheweth a great activity: and the great activity sheweth a great percussioⁿ, burning being effected by a kind of attrition of the thing burned. And the great force which fire sheweth in gunnes, and in mines, being but a multiplication of the same, doth evidently convince that of its own nature it maketh a strong percussioⁿ, when all due circumstances concur. Whereas it hath but little effect if the due circumstances be wanting; as we may observe in the insensible burning of so rarified a body as pure spirit of wine converted into flame.

But we must examine the matter more particularly, and must seek the cause why a violent effect doth not alwayes appear, wheresoever light striketh; for the which we are to note that three things do concur to make a percussioⁿ great: The bignesse, the density, and the celerity of the body moved. Of which three there is onely one in light; to wit, celerity: for it hath the greatest rarity, and the rayes of it are the smallest parcels of all naturall bodies. And therefore since onely celerity is considerable in the account of lights percussions, we must examine what celerity is necessary to make the stroke of a ray sensible: first then we see that all the motes of the aire, nay even feathers and straws, do make no sensible percussioⁿ when they fall upon us: therefore we must in light have at the least a celerity that may be to the celerity of the straw falling upon our hand (for example,) as the density of the straw is to the density of light, that the percussioⁿ of light may be in the least degree sensible. But let us take a corn of gunpowder in stead of a straw (between which there cannot be much difference) and then putting that the density of fire is to the density of gunpowder as

1. to 125000; and that the density of the light we have here in the earth, is to the density of that part of fire which is in the sunnes body, as the body of the sunne is to that body which is called *Orbis magnus* (whose semidiameter is the distance between the sunne and the earth;) which must be in subtriple proportion of the diameter of the sunne to the diameter of the great orb: it followeth that 125000. being multiplied by the proportion of the great orb unto the sunne (which Galileo telleth us is as 106000000. unto one) will give a scantling of what degree of celerity light must have more then a corn of gunpowder, to recompence the excesse of weight which is in a corn of gunpowder, above that which is in a ray of light, as big as a corn of gunpowder. Which will amount to be much greater then the proportion of the semidiameter of *Orbis magnus*, to the semidiameter of the corn of gunpowder: for if you reckon five grains of gunpowder to a barley-corns breadth, and 12. of them in an inch, and 12. inches in a foot, and 3. feet in a pace, and 1000. paces in a mile, and 3500. miles in the semidiameter of the earth, and 1208. semidiameters of the earth in the semidiameter of the *Orbis magnus*, there will be in it but 9132480000000. grains of gunpowder; whereas the other calculation maketh light to be 132500000000000. times rarer then gunpowder; which is almost ten times a greater proportion then the other. And yet this celerity supplyeth but one of the two conditions wanting in light to make its percussions sensible, namely density. Now because the same velocity in a body of a lesser bulk, doth not make so great a percussion as it doth in a bigger body; and that the littleness of the least parts of bodies followeth the proportion of their rarity; this vast proportion of celerity must again be drawn into it self, to supply for the excesse in bignesse that a corn of gunpowder hath over an atome of light: and the product of this multiplication will be the celerity required to supply for both defects. Which evidently sheweth, it is impossible that a ray of light should make any sensible percussion, though it be a body. Especially considering that sense never taketh notice of what is perpetually done in a moderate degree. And therefore after this minute looking into all circumstances, we need not have difficulty in allowing unto light the greatest celerity imaginable, and a percussion proportionate to such a celerity in so rare a body;

and

and yet not fear any violent effect from its blows : unlesse it be condensed, and many parts of it be brought together to work as if they were but one.

7.
The reason why
the body of
light is never
perceived to be
fanned by the
wind.

As concerning the last objection; that if light were a body, it would be fanned by the wind: we must consider what is the cause of a things appearing to be moved: & then examine what force that cause hath in light. As for the first part; we see that when a body is discerned now in one place, now in another, then it appeareth to be moved. And this we see happeneth also in light; as when the sunne or a candle is carried or moveth, the light thereof in the body of the candle or sunne seemeth to be moved along with it. And the like is in a shining cloud or comet.

But to apply this to our purpose : We must note that the intention of the objection is, that the light which goeth from the fire to an opacous body farre distant without interruption of its continuity, should seem to be jogged or put out of its way by the wind that crosseth it. Wherein the first failing is, that the object our conceiveth light to send species unto our eye from the midst of its line: whereas with a little consideration he may perceive, that no light is seen by us but that which is reflected from an opacous body to our eye: so that the light he meaneth in his objection is never seen at all. Secondly, it is manifest that the light which striketh our eye, doth strike it in a straight line; and seemeth to be at the end of that straight line, wheresoever that is; and so can never appear to be in another place: but the light which we see in another place, we conceive to be another light. Which maketh it again evident, that the light can never appear to shake, though we should suppose that light may be seen from the middle of its line; for no part of wind or aire can come into any sensible place in that middle of the line, with such speed that new light from the source doth not illuminate it sooner then it can be seen by us: wherefore it will appear to us illuminated, as being in that place: and therefore the light can never appear shaken. And lastly, it is easier for the aire or wind to destroy the light, then it is to remove it out of its place, wherefore it can never so remove it out of its place, as that we should see it in another place. But if it should remove it, it would wrap it up within it self and hide it.

8. In conclusion; after this long dispute concerning the nature
of

of light; if we consider well what hath been said on both sides (to which much more might be added, but that we have already trespassed in length, and I conceive enough is said to decide the matter) an equall judge will find the ballance of the question to hang upon these termes: that, to prove the nature of light to be materiall and corporeall, are brought a company of accidents well known to be the proprieties of quantitie or bodies; and as well known to be in light. Even so farre as that it is manifest that light in its beginning before it be dispersed is fire; and if again it be gathered together, it sheweth it self again to be fire. And the receptacles of it are the receptacles of a body: being a multitude of pores, as the hardnesse and coldnesse of transparent things do give us to understand; of which we shall hereafter have occasion to discourse.

The reasons for
& against lightes
being a body,
compared to-
gether.

On the contrary side, whatsoever arguments are brought against lightes being a body, are onely negatives. As that we see not any motion of light; that we do not discern where the confines are between light and aire; that we see not room for both of them, or for more lights to be together; and the like: which is to oppose negative proofs against affirmative ones; and to build a doctrine upon the defect of our senses; or upon the likeness of bodies which are extremely unlike, expecting the same effects from the most subtile as from the most grosse ones. All which together with the authority of Aristotle and his followers, have turned light into darknesse, and have made us almost deny the light of our own eyes.

Now then; to take our leave of this important question: let us return to the principles from whence we began, and consider; that seeing fire is the most rare of all the Elements, and very dry: and that out of the former it hath, that it may be cut into very small pieces; and out of the latter, that it conserveth its own figure, and so is apt to divide whatsoever fluide body: and joyning to these two principles, that it multiplyeth extremely in its source. It must of necessity follow, that it shooteth out in great multitudes little small parts into the aire and into other bodies circumfused with great dilatation in a spherickall manner. And likewise that these little parts are easily broken; and new ones still following the former, are still multiplied in straight lines from the place where they break. Out of which it is evi-
dent

9.
A summary re-
petition of the
reasons which
prove that light
is fire.

dent that of necessity it must in a manner fill all places, and that no sensible place is so little, but that fire will be found in it, if the medium be capacious. As also, that its extreme least parts will be very easily swallowed up in the parts of the aire, which are humide; and by their enfolding, be as it were quite lost; so as to lose the appearance of fire. Again; that in its reflections, it will follow the nature of grosser bodies, and have glidings like them; which is that we call refractions. That little streamings from it will crosse one another in excessive great numbers, in an unsensible part of space, without hindring one another. That its motion will be quicker then sense can judge of; and therefore will seem to move in an instant, or to stand still as in a stagnation. That if there be any bodies so porous with little and thick pores; as that the pores arrive near unto equalling the substance of the body; then, such a body will be so filled with these little particles of fire, that it will appear as if there were no stop in its passage, but were all filled with fire; and yet, many of these little parts will be reflected. And whatsoever qualities else we find in light, we shall be able to derive them out of these principles, and shew that fire must of necessity do what experience teacheth us that light doth. That is to say in one word, it will shew us that fire is light. But if fire be light, then light must needs be fire. And so we leave this matter

CHAP. IX.

Of Locall motion in common.

I.
No locall motion can be performed without succession.

THough in the fifth chapter, we made onely earth the pretender in the controversie against fire for superiority in activity; (and in very truth, the greatest force of gravity doth appear in those bodies which are eminently earthy:) nevertheless, both water and aire (as appeareth out of the 4. chapter of the Elements) do agree with earth, in having gravity. And gravity, is the chief virtue to make them efficient. So that upon the matter, this plea is common to all the three Elements.

Wherefore, to explicate this virtue, whereby these three weighty Elements do work; let us call to mind what we said in the beginning of the last chapter concerning locall motion: to wit, that according as the body moved, or the divider did more and more enter into the divided body; so, it did joyn it self to

some new parts of the medium or divided body, and did in like manner forsake others. Whence it happeneth that in every part of motion, it possesseth a greater part of the medium then it self can fill at once. And because by the limitation and confinednesse of every magnitude unto just what it is, and no more; it is impossible that a lesser body should at once equalise a greater: it followeth that this division or motion whereby a body attaineth to fill a place bigger then it self, must be done successively: that is, it must first fill one part of the place it moveth in, then another; and so proceed on, till it have measured it self with every part of the place from the first beginning of the line of motion to the last period of it where the body resteth.

By which discourse it is evident, that there cannot in nature be a strength so great as to make the least or quickest moveable that is, to passe in an instant, or all together, over the least place that can be imagined: for that would make the moved body (remaining what it is, in regard of its bignesse) to equalise and fit a thing bigger then it is. Therefore it is manifest, that motion must consist of such parts as have this nature, that whiles one of them is in being, the others are not yet: and as by degrees every new one cometh to be; all the others that were before, do vanish and cease to be. Which circumstance accompanying motion, we call Succession.

And whatsoever is so done, is said to be done *in time*: which is the common measure of all succession, for the change of situation of the starres, but especially of the sunne and moon, is observed more or lesse by all mankind: and appeareth alike to every man: and (being the most known, constant, and uniform succession that men are used unto) is as it were by nature it self set in their way and offered unto them as fittest to estimate and judge all other particular successions, by comparing them both to it, and among themselves by it. And accordingly we see all men naturally measure all other successions, and expresse their quantities, by comparing them to the revolutions of the heavens; for dayes, houres, and years, are nothing else but they, or some determinate parts of them: unto some of which, all other motions and successions must of necessity be referred, if we will measure them. And thus we see how all the mystery of applying time unto particular motions, is nothing else but the
considering

2.

Time is the common measure of all succession.

considering how farre the Agent that moveth the sunne, causeth it to go on in its journey, whiles the Agent that moveth a particular body, causeth it to perform its motion.

3.
What velocity
is, and that it
cannot be infi-
nite.

So that it is evident, that velocity is the effect of the superproportion of the one Agent over a certain medium; in respect of the proportion which another Agent hath to the same medium. And therefore, velocity is a quality by which one succession is intrinsically distinguished from another: though our explication, useth to include time in the notions of velocity and tardity. Velocity then, is the effect (as we said) of more strength in the Agent. And having before expressed, that velocity is a kind of density; we find that this kind of density is an excellency in succession; as permanent density, is an excellency in the nature of substance; though an imperfection in the nature of quantity (by which we see, that quantity is a kind of base alloy added to substance.) And out of this it is evident, that by how much the quicker the motion is in equall mediums, by so much the agent is the perfecter which causeth it to be so quick. Wherefore, if the velocity should ascend so much as to admit no proportion betweene the quicknesse of the one and the tardity of the other, all other circumstances being even, excepting the difference of the agents; then there must be no proportion between the agents. Nor indeed can there be any proportion between them though there were never so great differences in other circumstances, as long as those differences be within any proportion. And consequently, you see that if one agent be supposed to move in an instant, and another in time; whatsoever other differences be in the bodies moved and in the mediums; neverthelesse the agent which causeth motion in an instant will be infinite in respect of the agent which moveth in time. Which is impossible: it being the nature of a body, that greater quantity of the same thing hath greater virtue, then a lesse quantity hath; and therefore, for a body to have infinite virtue, it must have infinite magnitude.

If any should say the contrary; affirming that infinite virtue may be in a finite body; I ask, whether in half that body (were in divided) the virtue would be infinite or no? If he acknowledge that it would not; I inferre thence, that neither in the two parts together there can be infinite virtue: for two finies cannot com-
pose

pose and make up one infinite. But if he will have the virtue be infinite in each half, he therein alloweth that there is no more virtue, in the whole body then in one half of it: which is against the nature of bodies. Now that a body cannot be infinite in greatnesse, is proved in the second knot of Master Whites first Dialogue of the world. And thus it is evident, that by the virtue of pure bodies there can be no motion in an instant.

On the other side it followeth that there cannot be so little a force in nature, but that giving it time enough, it will move the greatest weight that can be imagined: for the things we treat of, being all of them quantities; they may by division and multiplication, be brought unto equality. As for example; supposing the weight of a moveable, to be a million of pounds; and that the mover is able to move the millioneth part of one of those pounds, in a million of years, the millioneth part of a pace, through a medium of a certain rarity. Now, seeing that years may be multiplied so, as to equalize the force of this mover, unto the weight of the moveable: it followeth clearly that in so many millions of years, this force may move the whole weight of a million of pounds, through the determined medium in a determinate number of millions of years, a million of paces: for such a force is equall to the required effect; and by consequence, if the effect should not follow, there would be a compleat cause put, and no effect result from it.

But peradventure it is needfull to illustrate this point yet further: suppose then a weight never so great to be A, and a force never so little to be B. Now if you conceive that some other force moveth A, you must withall conceive that it moveth A some space, since all motion implieth necessarily that it be through some space: let that space be CD. And because a body cannot be moved in a space in an instant, but requireth some time to have its motion performed in; it followeth, that there must be a determined time, in which the conceived force must move the weight A through the space CD: let that time be EF. Now then, this is evident that it is all one to say that B moveth A, and to say that B moveth A through a space in a time; so that if any part of this be left out, it cannot be understood that B moveth A. Therefore to expresse particularly the effect which B is to do upon A, we must say that B must move A a certain

4.
No force so little, that is not able to move the greatest weight imaginable.

space in a certain time. Which being so, we may in the next place consider that this effect of moving A may be diminished 2 waies, either because the space it is to be moved in, is lessened; or the time taken up in its motion, is increased: for, as it is a greater effect, to move A through the space CD, in a lesse time then EF, so it is a lesse effect to move the same A, through the space CD, in a greater time then EF; or through a lesse space then CD in the time EF. Now then, this being supposed, that it is a lesse effect to move A through CD, in a greater time then EF, it followeth also, that a lesser virtue is able to move it through CD in a greater time then EF, then the virtue which is required to move it, through the same space in the time EF. Which if it be once granted (as it cannot be denied) then multiplying the time, as much as the virtue or force required to move A through CD in the time EF is greater then the force B; in so much time, the force B will be able to move A through CD. Which discourse is evident, if we take it in the common terms: but if it be applied to action, wherein physicall accidents intervenc, the artificer must have the judgement to provide for them, according to the nature of his matter.

5.
The chief principle of Mechanicks deduced out of the former discourse.

Upon this last discourse doth hang the principle which governeth Mechanicks, to wit, that the force and the distance of weights counterpoysing one another, ought to be reciprocal. That is, that by how much the one weight is heavier then the other, by so much must the distance of the lighter from the fixed point upon which they are moved, be greater then the distance of the greater weight from the same point: for it is plain that the weight which is more distant, must be moved a greater space then the nearer weight in the proportion of the two distances. Wherefore the force moving it must carry it in a velocity of the said proportion to the velocity of the other. And consequently, the Agent, or mover, must be in that proportion more powerfull then the contrary mover. And out of this practise of Geometricians in Mechanicks (which is confirmed by experience) it is made evident that if other conditions be equall, the excesse of so much gravity will make so much velocity. And so much velocity in proportion, wil recompence so much gravity

6.
No moveable can passe from

that nothing recedeth from quiet or rest, and attaineth a great

degree

degree of celerity, but it must passe through all the degrees of celerity that are below the obtained degree. And the like is, in passing from any lesser degree of velocity unto a greater: because it must passe through all the intermediate degrees of velocity. For by the declaration of velocity, which we have even now made, we see that there is as much resistance in the medium to be overcome with speed, as there is for it to be overcome in regard of the quantity; or line of extent of it: because (as we have said) the force of the Agent in counterpoises, ought to be increased as much as the line of extent of the medium, which is to be overcome by the Agent in equal time, doth exceed the line of extent of the medium, along which the resistant body is to be moved. Wherefore, it being proved that no line of extent can be overcome in an instant, it followeth, that no defect of velocity which requireth as great a superproportion in the cause, can be overcome likewise in an instant.

And by the same reason by which we prove that a moveable cannot be drawn in an instant from a lower degree of velocity to a higher, it is with no lesse evidence concluded that no degree of velocity can be attained in an instant: for divide that degree of velocity into two halves, and if the Agent had overcome the one halfe, he could not overcome the other halfe in an instant: much lesse therefore is he able to overcome the whole (that is, to reduce the moveable from quiet to the said degree of velocity) in an instant.

Another reason may be, because the movers themselves (such movers as we treat of here) are bodies likewise moved, and do consist of parts: whereof not every one part, but a competent number of them, doth make the moving body to be a fit Agent able to move the proposed body in a proposed degree of celerity. Now this Agent meeting with resistance in the moveable, and not being in the utmost extremity of density; but condensable yet further, (because it is a body;) and that every resistance (be it never so small) doth work something upon the mover (though never so hard) to condense it; the parts of the mover that are to overcome this resistance in the moveable, must (to work that effect) be condensed and brought together as close as is needfull, by this resistance of the moveable to the mo-

rest to any determinate degree of velocity, or from a lesser degree to a greater, without passing through all the intermediate degrees, which are below the obtained degree

mover : and so, the remote parts of the mover, become nearer to the moveable, which cannot be done but successively, because it includeth locall motion. And this application being likewise divisible, and not all the parts flocking together in an instant to the place where they are to exercise their power; it followeth, that whiles there are fewer moving parts knit together, they must needs move lesse and more weakly, then when more or all of them are assembled and applied to that work. So that, the motive virtue encreasing thus in proportion to the multiplying of the parts applied to cause the motion ; of necessity, the effect (which is obedience to be moved, and quicknesse of motion in the moveable) must do so too: that is, it must from nothing, or from rest, passe through all the degrees of celerity untill it arrive to that which all the parts together are able to cause.

As for example, when with my hand I strike a ball ; till my hand toucheth it, it is in quiet; but then it beginneth to move; yet with such resistance, that although it obey in some measure the stroke of my hand, neverthelesse it presseth the yielding flesh of my palm backwards towards the upper and bony part of it. That part then overtaking the other, by the continued motion of my hand ; and both of them joyning together to force the ball away ; the impulse becometh stronger, then at the first touching of it. And the longer it presseth upon it, the more the parts of my hand do condense and unite themselves to exercise their force; and the ball therefore must yield the more ; and consequently the motion of it groweth quicker and quicker, till my hand parteth from it. Which condensation of the parts of my hand encreasing successively by the parts joyning closer to one another, the velocity of the balls motion (which is an effect of it) must also encrease proportionably thereunto. And in like manner the motion of my hand and arm, must grow quicker and quicker and passe all the degrees of velocity between rest and the utmost degree it attaineth unto : for seeing they are the spirits swelling the nerves, that cause the arms motion, (as we shall hereafter shew ;) upon its resistance, they flock from other parts of the body to overcome that resistance. And since their journey thither requireth time to perform it in ; and that the nearest come first ; it must needs follow, that as they grow more and more in number , they must more

powerfully overcome the resistance; and consequently, increase the velocity of the motion, in the same proportion as they flock thither; untill it attain that degree of velocity, which is the utmost period that the power, which the Agent hath to overcome the resistance of the medium can bring it self unto. Between which and rest, or any other inferiour degree of velocitie, there may be designed infinite intermediate degrees, proportionable to the infinite divisibility of time, and space, in which the mover doth move. Which degrees do arise out of the reciprocally yielding of the medium. And that is likewise divisible in the same infinite proportion.

Since then, the power of all naturall Agents is limited; the mover (be it never so powerfull) must be confined to observe these proportions; and cannot passe over all these infinite designable degrees in an instant; but must allot some time (which hath a like infinity of designable parts) to ballance this infinity of degrees of velocity; and so consequently, it requireth time, to attain unto any determinate degree. And therefore cannot recede immediately from rest unto any degree of celerity, but must necessarily passe through all the intermediate ones.

Thus it is evident that all motion which hath a beginning must of necessity increase for some time. And since the works of nature are in proportion to their causes, it followeth that this increase is in a determinate proportion. Which Galileus (unto whom we owe the greatest part of what is known concerning motion) teacheth us how to find out; and to discover what degree of celerity any moveable that is moved by nature, hath in any determinate part of the space it moveth in.

Having settled these conditions of motion; we shall do well in the next place to enquire after the causes of it: as well in the body moved, as also in the mover that occasioneth the motion. And because we have already shewed, that locall motion is nothing in substance but division: we may determine that those causes which contribute to division, or resist it, are the causes which make or resist locall motion. It hath also been said, that Density hath in it a power of dividing: and that Rarity is the cause of being divided; likewise we have said that fire by reason of its smal parts, into which it may be cut (which maketh them sharp) hath also an eminence in dividing: so that we have two qualities, density and tenuity

7.
The conditions which help to motion, in the moveable are three; in the medium one.

Dialog. 1. of
Motion.

or sharpnesse which concurre actively to division. We have told you also how Galileus hath demonstrated that a greater quantity of the same figure and density, hath a priviledge of descending faster then a lesser. And that priviledge consisteth in this, that the proportion of the superficies to the body it limiteth (which proportion the greater it is, the more it retardeth) is lesse in a greater bulk then in a smaller.

We have therefore three conditions concurring to make the motion more efficacious: namely, the density, the sharpnesse, and the bulk of the moveable. And more then these three, we cannot expect to find in a moved body: for quantity hath but three determinations: one, by density and rarity; of which, density is one of the three conditions: another, by its parts; as by a foot, a span, &c. and in this way we have found that the greater excelleth the lesser: the third and last, is by its figure; and in this we find that subtile or edged quantities do prevail over blunt ones. Seeing therefore, that these three determinations be all that are in quantity; there can be no more conditions in the body moved (which of necessity is a finite quantity) but the three named.

And as for the medium which is to be divided, there is onely rarity and density (the one, to help; the other, to hinder,) that require consideration on its side. For neither figure, nor littleness and greatnesse, do make any variation in it. And as for the Agent, it is not as yet time, before we have looked further into the nature of motion, to determine his qualities.

8.
No body hath any intrinsecall virtue to move it self towards any determinate part of the universe.

Now then let us reflect how these three conditions do all agree in this circumstance, that they help nothing to division, unlesse the body in which they are, be moved and pressed against the body that is to be divided, so that we see no principle to perswade us, that any body can move it self towards any determinate part or place of the universe, of its owne intrinsecall inclination. For besides that the learned Author of the Dialogues de Mundo (in his third Dialogue, and the second knot) hath demonstrated that a body cannot move unlesse it be moved by some extrinsecall Agent; we may easily frame unto our selves a conceit, of how absurd it is to think that a body by a quality in it can work upon it self: as if we should say, that rarity (which is but more quantity) could work upon quantity; or that figure (which is but that the body reacheth no further) could work upon

upon the body : and in generall, that the manner of any thing can work upon that thing whose manner it is. For Aristotle and Saint Thomas, and their intelligent commentatours, declaring the notion of *Quality*, tell us, that *to be a Quality* is nothing else but to be the determination or modification of the thing whose quality it is.

Besides, that the naturall manner of operation is, to work according to the capacity of the subject : but when a body is in the midst of an uniform medium or space, the subject is equally prepared on all sides to receive the action of that body. Wherefore (though we should allow it a force to move) if it be a naturall Agent, and have no understanding, it must work indifferently on all sides, and by consequence, cannot move on any side. For if you say that the Agent in this case (where the medium is uniform) worketh rather upon one side then upon another; it must be because this determination is within the Agent it self, and not out of the circumstant dispositions : which is the manner of working of those substances that work for an end of their own ; that is, of understanding creatures, and not of naturall bodies.

Now he that would exactly determine what motion a body hath, or is apt to have; determining by supposition the force of the Agent, must calculate the proportions of all these three conditions of the moveable, and the quality of the medium: which is a proceeding too particular for the intention of our discourse. But to speak in common, it will not be amisse to examine in what proportion, motion doth increase ; since we have concluded that all motion proceedeth from quiet by a continuall increase. Galileus (that miracle of our age, and whose wit was able to discover whatsoever he had a mind to employ it about) hath told us that naturall motion encreaseth in the proportion of the odde numbers. Which to expresse by example, is thus: suppose that in the going of the first yard it hath one degree of velocity, then in the going of the second yard it will have three degrees, and in going of the third it will have five : and so onwards, still adding two to the degrees of the velocity for every one, to the space. Or to expresse it more plainly; if in the first minute of time it goeth one yard of space, then in the next minute it will go three yards, in the third it will go five, in the fourth seven, and so forth.

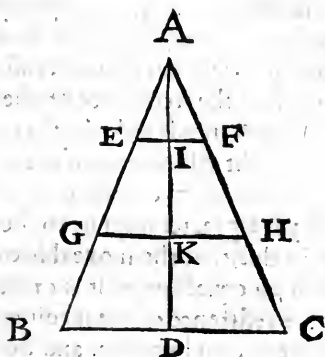
9.

The increase of motion is alwayes made in the proportion of the odde numbers.

But we must enlarge this proposition unto all motions, as we have done the former, of the encrease it self in velocity: because the reason of it is common to all motions. Which is, that all motion (as may appear out of what we have formerly said) proceedeth from two causes; namely, the Agent or the force that moveth, and the disposition of the body moved, as it is composed of the three qualities we lately explicated. In which is to be noted, that the Agent doth not move simply by its own virtue, but it applyeth also the virtue of the body moved, which it hath to divide the medium when it is put on. As when we cut with a knife, the effect proceedeth from the knife pressed on by the hand; or from the hand as applying and putting in action the edge and cutting power of the knife. Now this in Physicks and Nature is clearly parallel to what in Geometry and Arithmetick the Mathematicians call, drawing one number or one side into another; for as in Mathematicks, to draw one number into another is to apply the number drawn unto every part of the number into which it is drawn; as if we draw three into seven we make twenty one, by making every unity or part of the number seven to be three: and the like is of lines in Geometry. So in the present case, to every part of the hands motion, we adde the whole virtue of the cutting faculty which is in the knife; and to every part of the motion of the knife, we adde the whole pressing virtue of the hand. Therefore the encrease of the effect proceeding from two causes so working, must also be parallel to the encrease of the quantities arising out of the like drawing in Mathematicks. But in those, it is evident that the encrease is according to the order of the odde numbers, and therefore it must in our case be the like: that is, the encrease must be in the said proportion of odde numbers. Now that in those the encrease proceedeth so will be evident, if you consider the encrease of an Equicrure triangle; which because it goeth upon a certain proportion of length and breadth, if you compare the encreases of the whole triangle (that gaineth on each side) with the encreases of the perpendicular (which gaineth onely in length) you will see that they still proceed in the foresaid proportion of odde numbers.

Which will be better understood, if we set down the demonstration of it: let the Equicrure triangle be ABC : and from the point

point A, draw the line A D perpendicular to the line B C, & let it be divided into three equall parts by the lines E F and G H, in the points I and K. And I say that because the line A K is twice as long as the line A I, therefore the trapezium E F H G, is thrice as big as the triangle A E F: for as A K is to A I, so is G H to E F. But the triangle A G H



is to the triangle A E F, in a double proportion of the line G H to the line E F: which being double the proportion of one triangle to the other must be fourefold: so that subtracting the triangle AEF, the trapezium E F H G remaineth thrice as big as it: And thus the whole triangle getteth an encrease of three, whiles the perpendicular is increased but one, to make his length two. Which when it cometh to three, the trapezium GHCB that containeth the third division of the perpendicular, becometh five times as big as the triangle AEF; for since the line A D is three times as long as the line A I, and the line B C is three times as long as E F; it followeth that the triangle ABC is nine times as big as the triangle AEF; but AGH is foure times as big as AEF; therefore subtracting it from the whole triangle ABC, it leaveth the trapezium GHCB five times as big as the first triangle AEF. Which proposition is very ingeniously set down by the learned Monsieur Gassendi in his first Epistle *de motu impresso a motore translato*, to the same purpose for which we bring it. Though we do not here make use of his scheme and way of demonstration; because we had fallen upon this before his book came abroad: and therefore we onely note his to direct the Reader unto it, who peradventure may like his better then ours. Howbeit we do not conceive that he hath in his discourse there, arrived to the true reason of the effect we search into: as may appear by what we have already delivered.

But we must not imagine, that the velocity of motion will always encrease thus for as long as we can fancy any motion: but when it is arrived unto the utmost period that such a moveable with such causes is capable of, then it keepeth constantly

10.
No motion can encrease for ever without coming to a period.

the same pace, and goeth equally and uniformly at the same rate. For since the density of the moveable, and the force of the Agent moving it, (which two do cause the motion) have a limited proportion to the resistance of the medium, how yielding soever it be; it must needs follow, that when the motion is arrived unto that height which ariseth out of this proportion, it cannot exceed it, but must continue at that rate, unless some other cause give yet a greater impulse to the moveable. For velocity consisting in this, that the moveable cutteth through more of the medium in an equall time; it is evident that in the encrease of velocity, the resistance of the medium which is overcome by it; groweth greater and greater, and by little and little gaineth upon the force of the Agent; so that the superproportion of the Agent, groweth still lesser and lesser as the velocity encreaseth: and therefore at the length they must come to be ballanced. And then the velocity can encrease no more.

And the reason of the encrease of it for a while at the beginning, is because that coming from rest, it must passe through all the intermediate degrees of velocity before it can attain to the height of it, which requireth time to perform, and therefore falleth under the power of our sense to observe. But because we see it do so for some time, we must not therefore conclude that the nature of such motion is still to encrease without any period or limit; like those lines that perpetually grow nearer, and yet can never meet: for we see that our reason examining the causes of this velocity, assureth us that in continuance of time and space, it may come to its height which it cannot exceed.

And there would be the pitch at which distance weights being let fall, would give the greatest strokes and make greatest impressions. It is true that Galileus and Merfenius (two exact experimenters) do think they find this verity by their experiences. But surely that is impossible to be done: for the encrease of velocity being in a proportion ever diminishing, it must of necessity come to an insensible encrease in proportion before it endeth: for the space which the moveable goeth through is still encreased; and the time wherein it passeth through that space remaineth still the same little one as was taken up in passing a lesse space immediately before; and such little differences of great spaces passed over in a little time, come soon to be undiscernable by sense. But reason (which sheweth us, that if velocity never ceased
from

from increasing, it would in time arrive to exceed any particular velocity; and by consequence, the proportion which the mover hath to the medium; because of the adding still a determinate part to its velocity) concluding plainly that it is impossible, motion should increase for ever, without coming to a period.

Now the impression which falling weights do make, is of two kinds; for the body into which impression is made, either can yield backward, or it cannot. If it can yield backward, then the impression made is a motion: as we see a stroke with a racket upon a ball, or with a pail-mill beetle upon a bowl maketh it flie from it. But if the stricken body cannot yield backwards, then it maketh it yield on the sides. And this, in divers manners: for if the smitten body be drie and brittle, it is subject to break it; and make the peices flie round about: but if it be a tough body, it squeezech it into a larger form.

But because the effect in any of these wayes is eminently greater then the force of the Agent seemeth to be; it is worth our labour to look into the causes of it. To which end we may remember how we have already declared that the force of the velocity is equall to a reciprocall force of weight in the virtue movent: wherefore the effect of a blow that a man giveth with a hammer, dependeth upon the weight of the hammer, upon the velocity of the motion, and upon the hand, in case the hand accompanieth the blow. But if the motion of the hand ceaseth before (as when we throw a thing) then onely the velocity and the weight of the hammer remain to be considered. Howsoever, let us put the hand and weight in one summe which we may equalize by some other virtue or weight. Then let us consider the way or space, which a weight lying upon the thing is to go forwards to do the same effect in the same time as the percassion doth. And what excessse the line of the blow, hath over the line of that way or space; such an excessse we must adde of equall weight or force, to the weight we had already taken. And the weight composed of both; will be a fit Agent to make the like impression. This Probleme was proposed unto me by that worthy religious man, Father Merfenius: who is not content with advancing learning by his own industry and labours; but besides, is alwayes (out of his generous affection to verity) inciting others to contribute to the publick stock of it.

He proposed to me likewise this following question, to wit,

II.

Certain problems resolved concerning the proportion of some moving Agents compared to their effects.

why there is required a weight of water in double Geometrical proportion, to make a pipe run twice as fast as it did, or to have twice as much water run out in the same time? Unto which I answer out of the same ground as before: That because in running twice as fast, there goeth out double water in every part of time; and again, every part of water goeth a double space in the same part of time; that is to say, because double the celerity is drawn into double the water, and double the water into double the celerity; therefore the present effect is to the former effect, as the effect or quadrate of a double line drawn into it self, is to the effect or quadrate of half the said line drawn into it self. And consequently the cause of the latter effect (which is the weight then) must be to the cause of the former effect (that is, to the former weight) in the same proportion; namely, as the quadrate of a double line, is to the quadrate of half that line. And so you see the reason of what he by experience findeth to be true. Though I doubt not but when he shall set out the Treatise which he hath made of this subject, the Reader will have better satisfaction.

In the mean while, an experience which Galileo delivereth will confirm this doctrine. He saith, that to make the same pendant go twice as fast as it did, or to make every undulation of it in half the time it did; you must make the line at which it hangeth, double in Geometrical proportion to the line at which it hanged before. Whence it followeth, that the circle by which it goeth is likewise in double Geometrical proportion. And this being certain, that celerity to celerity hath the proportion of force, which weight hath to weight; it is evident, that as in one case there must be weight in Geometrical proportion; so in the other case, where onely celerity maketh the variance, the celerity must be in double Geometrical proportion, according as Galileo findeth it by experience.

But to return to our main intent, there is to be further noted; that if the subject stricken be of a proportionate cessibility; it seemeth to dull and deaden the stroke: whereas, if the thing stricken be hard, the stroke seemeth to lose no force, but to work a greater effect. Though indeed the truth be, that in both cases the effects are equal; but diverse according to the natures of the things that are stricken; for no force that once is in nature can be lost, but must have its adequate effect one way or other.

Let us then first suppose the body stricken to be a hard body of no exceeding bignesse: in which case, if the stroke light perpendicularly upon it, it will carry such a body before it. But if the body be too great, and have its parts so conjoynded, as that they are weaker then the stroke; in this case the stroke driveth one part before it, and so breaketh it from the rest. But lastly, if the parts of the stricken body be so easily cessible, as without difficulty the stroke can divide them, then it entereth into such a body untill it hath spent its force. So that now making up our account, we see that an equall effect proceedeth from an equall force in all the three cases; though in themselves they be far different. But we are apt to account that effect greater, which is more considerable unto us by the profit or damage it bringeth us. And therefore we usually say, that the blow which shaketh a wall, or beateth it down, and killeth men with the stones it scattereth abroad; hath a greater effect then that which penetrateth far into a mud wall, and doth little harm: for that innocuousnesse of the effect, maketh that although in it self it be as great as the other, yet it is little observed or considered.

This discourse draweth on another: which is to declare how motion ceaseth. And to summe that up in short, we say that when motion cometh unto rest, it decreaseth & passeth through all the degrees of celerity and tardity that are between rest and the height of that motion which so declineth: and that in the proportion of the odde numbers, as we declared above, that it did encrease. The reason is clear: because that which maketh a motion cease, is the resistance it findeth: which resistance is an action of a mover that moveth something against the body which is moved, or something equivalent to such an action: wherefore it must follow the laws that are common to all motions: of which kind those two are that we have expressed in this conclusion. Now that resistance is a countermotion, or equivalent to one, is plain by this; that any body which is pressed must needs presse again upon the body that presseth it; wherefore the cause that hindereth such a body from yielding, is a force moving that body against the body which presseth it. The particulars of all which we shall more at large declare, where we speak of the action and reaction of particular bodies.

I 2.

When a moveable cometh to rest, the motion doth decrease according to the rules of encrease.

CHAP. X.

Of Gravity and Levity; and of Locall Motion, commonly termed Naturall.

I.

Those motions are called naturall which have constant causes, & those violent which are contrary to them.

IT is now time to consider that distinction of motions which is so famous in Aristotle; to wit, that some motions are naturall, others violent: and to determine what may be signified by these terms. For seeing we have said that no body hath a naturall intrinsecall inclination unto any place, to which it is able to move it self; we must needs conclude that the motion of every body followeth the percussion of extrinsecall Agents. It seemeth therefore impossible that any body should have any motion naturall to it self. And if there be none naturall, there can be none violent. And so this distinction will vanish to nothing. But on the other side, living creatures do manifestly shew naturall motions, having naturall instruments to perform certain motions; wherefore such motions must of necessity be naturall to them. But these are not the motions which we are to speak of; for Aristotles division is common to all bodies, or at the least to all those we converse withall: and particularly to those which are called heavy and light; which two terms passe through all the bodies we have notice of.

Therefore proceeding upon our grounds before layed; to wit, that no body can be moved of it self; we may determine those motions to be naturall unto bodies which have constant causes, or percipients to make them alwayes in such bodies: and those violent which are contrary to such naturall motions. Which being supposed, we must search out the causes that so constantly make some bodies descend towards the center or middle of the earth; and others to rise and go from the center: by which the world is subject to those restless motions, that keep all things in perpetuall flux, in this changing sphere of action and passion.

2.

The first and most generall operation of the sunne, is the making and raising of atomes.

Let us then begin with considering what effects the sunne (which is a constant and perpetuall cause) worketh upon inferiour bodies, by his being regularly sometimes present and sometimes absent. Observe in a pot of water hanging over a fire, how the heat maketh some parts of the water to ascend, and others to supply the room by descending, so that

that as long as it boyleth, it is in a perpetuall confused motion up and down. Now having formerly concluded that *fire is light, and light is fire*; it cannot be doubted but that the sunne doth serve in stead of fire to our globe of earth and water, (which may be fitly compared to the boyling pot;) and all the day long draweth vapours from those bodies that his beams strike upon. For he shooting his little darts of fire in multitudes, and in continued streams from his own center against the Python the earth we live on; they do there overtake one another, and cause some degree of heat as farre as they sink in. But not being able (by reason of their great expansion in their long journey) to convert it into their own nature and set it on fire, (which requireth a high degree of condensation of the beams) they do but pierce & divide it very subtilly, and cut some of the outward parts of it into extreme little atomes. Unto which they sticking very close, and being in a manner incorporated with them (by reason of the moysture that is in them) they do in their rebound back from the earth carry them along with them; like a ball that struck against a moist wall, doth in its return from it, bring back some of the mortar sticking upon it. For the distance of the earth from the sun is not the utmost period of these nimble bodies flight; so that when by this solid body they are stopped in their course forwards on, they leap back from it, and carry some little parts of it with them: some of them a farther, some of them a shorter journey; according as their littleness and rarity make them fit to ascend. As is manifest by the consent of all Authours that write of the regions of the aire; who determine the lower region to reach as farre as the reflection of the sunne; and conclude this region to be very hot.

For if we mark how the heat of fire is greatest, when it is incorporated in some dense body; (as in iron or in sea-coal) we shall easily conceive that the heat of this region proceedeth mainly out of the incorporation of light with those little bodies which stick to it in its reflexion. And experience testifieth the same, both in our fouldry dayes, which we see are of a grosse temper, and ordinarily go before rain: as also in the hot springs of extreme cold countreys, where the first heats are unsufferable; which proceed out of the resolution of humidity congealed; & in
hot

in hot winds (which the Spaniards call *Bochornos* from *Boca de horno* by allusion to the breathing steam of an oven when it is opened) which do manifestly shew that the heat of the sunne is incorporated in the little bodies, which compose the steam of that wind. And by the principles we have already layed, the same would be evident; though we had no experience to instruct us; for seeing that the body of fire is dry, the wet parts (which are easiest resolved by fire) must needs stick unto them, and accompany them in their return from the earth.

3.

The light rebounding from the earth with atomes, causeth two streams in the aire; the one ascending the other descending; and both of them in a perpendicular line.

Now whiles these ascend, the aire must needs cause others that are of a grosser complexion to descend as fast, to make room for the former, and to fill the places they left, that there may be no vacuity in nature. And to find what parts they are and from whence they come, that succeed in the room of light and atomes glewed together that thus ascend; we may take a hint from the maxime of the Opticks, that light reflecting maketh equal angles; whence, supposing the superficies of the earth to be circular, it will follow that a perpendicular to the center passeth just in the middle between the two rayes; the incident and the reflected. Wherefore the aire between these two rayes, and such bodies as are in it being equally pressed on both sides; those bodies which are just in the middle, are nearest and likeliest to succeed immediately in the room of the light and atomes which ascend from the superficies of the earth: and their motion to that point is upon the perpendicular. Hence it is evident, that the aire and all such bodies as descend to supply the place of light and atomes, which ascend from the earth, do descend perpendicularly towards the center of the earth.

And again, such bodies as by the force of light being cut from the earth or water, do not ascend in form of light, but do incorporate a hidden light and heat within them; (and thereby are rarer then these descending bodies) must of necessity be lifted up by the descent of those denser bodies that go downwards, because they, (by reason of their density) are moved with a greater force. And this lifting up must be in a perpendicular line; because the others descending on all sides perpendicularly, must needs raise those that are between them equally

equally from all sides : that is, perpendicularly from the center of the earth. And thus we see a motion set on foot, of some bodies continually descending, and others continually ascending : all in perpendicular lines, excepting those which follow the course of lights reflexion.

Again as soon as the declining sun groweth weaker or leaveth our horizon, and that his beams vanishing do leave the little horsemen which rode upon them, to their owne temper and nature (from whence they forced them) they finding themselves surrounded by a smart descending stream, do tumble down again in the night, as fast as in the day they were carried up ; and crowding into their former habitations, they exclude those that they find had usurped them in their absence. And thus, all bodies within reach of the sunnes power, but especially our aire, are in perpetuall motion ; the more rarified ones ascending, and the dense ones descending.

Now then ; because no bodies wheresoever they be (as we have already shewed) have any inclination to move towards a particular place, otherwise then as they are directed and impelled by extrinsecall Agents : let us suppose that a body were placed at liberty in the open aire. And then casting whether it would be moved from the place we suppose it in : and which way it would be moved ; we shall find that it must of necessity happen that it shall descend and fall down till it meet with some other grosse body to stay and support it. For although of it self it would move no way : yet if we find that any other body striketh efficaciously enough upon it ; we cannot doubt but that it will move that way which the striking body impelleth it. Now, it is stricken upon on both sides (above and below) by the ascending, and the descending atomes, the rare ones, striking upon the bottome of it, and driving it upwards, and the denser ones, pressing upon the top of it and bearing it downwards. But if you compare the impressions that the denser atomes make, with those that proceed from the rare ones ; it is evident that the dense ones must be the more powerfull ; and therefore will assuredly determine the motion of the body in the aire, that way they go, which is downwards.

Nor need we fear, lest the littleness of the agents, or the feebleness of their strokes, should not be sufficient to work this

4.
A dense body placed in the aire between the ascending and descending stream, must needs descend.

effect ; since there is no resistance in the body it self, and the aire is continually cut in pieces, by the sunne beams, and by the motions of little bodies ; so that the adhesion unto aire of the body to be moved, will be no hinderance to this motion: especially, considering the perpetuall new percussions, and the multitude of them, and how no force is so little, but that with time and multiplication it will overcome any resistance.

5.
A more particular explication of all the former doctrine touching gravitation.

But if any man desireth to look upon, as it were at one view, the whole chain of this doctrine of gravity : let him turn the first cast of his eyes upon what we have said of fire when we explicated the nature of it. To wit, that it beginneth from a little source ; and by extreme multiplication and rarefaction, it extendeth it self into a great sphere. And then he will perceive the reason why light is darted from the body of the sunne with that incredible celerity, wherewith its beams fly to visite the remotest parts of the world ; and how of necessity, it giveth motion to all circumstant bodies ; since it is violently thrust forward by so extreme a rarefaction ; and the further it goeth, is still the more rarified and dilated.

Next, let him reflect how infinitely the quicknesse of lights motion, doth prevent the motion of a moist body, such an one as aire is : and then he will plainly see, that the first motion which light is able to give unto the aire, must needs be a swelling of that moist element, perpendicularly round about the earth ; for, the ray descendent, and the ray reflectent, flying with so great a speed, that the aire between them cannot take a formall ply any way before the beams of light be on both sides of it: it followeth, that according to the nature of humide things, it must first onely swell : for that is the beginning of motion in them, when heat entereth into them, and worketh upon them. And thus he may confidently resolve himself, that the first motion which light causeth in the aire, will be a swelling of it between the two rayes towards the middle of them. That is ; perpendicularly from the surface of the earth.

And out of this, he will likewise plainly see, that if there be any other little dense bodies floating in the aire, they must likewise mount a little, through this swelling and rising of the aire. But that mounting will be no more then the immediate parts of the aire themselves do move. Because this motion is not by way

of impulse or stroke that the aire giveth those denser bodies; but by way of containing them in it, and carrying them with it, so that it giveth them no more celerity, then to make them go with it self, and as parts of it self.

Then, let him consider, that light or fire, by much beating upon the earth, divideth some little parts of it from others: whereof if any do become so small and tractable, as not to exceed the strength which the rayes have to manage them; the returning rayes, will at their going back, carry away with them or drive before them, such little atomes as they have made or meet with: & so fill the aire with little bodies cut out of the earth.

After this, let him consider that when light carrieth up an atome with it, the light and the atome do stick together, and do make one ascending body; in such sort as when an empty dish lyeth upon the water, the aire in the dish maketh one descendent body together with the dish it self: so that the density of the whole body of aire and dish (which in this case, are but as one body) is to be esteemed according to the density of the two parts; one of them being allayed by the other, as if the whole were throughout of such a proportion of density, as would arise out of the composition and kneading together the severall densities of those two parts. Now then, when these little compounded bodies of light and earth, are carried up to a determinate height; the parts of fire or light, do by little and little break away from them: and thereby, the bulk of the part which is left, becometh of a different degree of density (quantity for quantity) from the bulk of the entire atome, when light was part of it: and consequently it is denser then it was.

Besides, let him consider that when these bodies ascend; they do go from a narrow room to a large one, that is, from the centerwards to the circumference: but when they come down again, they go from a larger part to a narrower. Whence it followeth, that as they descend, they draw closer and closer together, and by consequence, are subject to meet and to fall in one with another; and thereby to increase their bulk, and to become more powerfull in density; not onely, by the losse of their fire; but also by the encrease of their quantity. And so it is evident, that they are denser coming down, then going up.

Lastly, let him consider, that those atomes which went up first,

and are parted from their volatile companions of fire or light, must begin to come down apace, when other new atomes (which still have their light incorporated with them) do ascend to where they are, and do go beyond them by reason of their greater levity. And as the latter atomes come up with a violence and a great celerity, so must the first go down with a smart impulse: and by consequence, being more dense then the aire in which they are carryed, must of necessity cut their way through that liquid and rare medium; and go the next way to supply the defect and room of the atomes which ascend; (that is, perpendicularly to the earth) and give the like motion to any body they find in their way, if it be susceptible of such a motion: which it is evident that all bodies are, unlesse they be stricken by some contrary impulse. For since that a bodies being in a *place*; is nothing else but the continuity of its outside to the inside of the body that containeth it and is its place, it can have no other repugnance to locall motion (which is nothing else but a successive changing of place) besides this continuity. Now the nature of density, being the power of dividing; and every least power having some force and efficacy, (as we have shewed above) it followeth that the stroke of every atome (either descending, or ascending) will work something upon any body (though never so big) it chanceth to incounter with, and strike upon in its way, unlesse there be as strong an impulse the contrary way, to oppose it. But it being determin'd, that the descending atomes are denser then those that ascend; it followeth that the descending ones will prevail. And consequently, all dense bodies must necessarily tend downwards, to the center (which is, to be *Heavy*) if some other more dense body do not hinder them.

6.

Out of this discourse, we may conclude that there is no such thing among bodies, as positive gravity or levity: but that their course upwards or downwards happeneth unto them by the order of nature, which by outward causes giveth them an impulse one of these wayes: without which, they would rest quietly wheresoever they are, as being of themselves indifferent to any motion. But because our words expresse our notions, and they are framed according to what appeareth unto us; when we observe any body to descend constantly towards our earth, we call it heavy; and if it move contrarywise, we call it light.

But

Gravity and levity do not signify an intrinsicall inclination to such a motion in the bodies themselves which are termed heavy and light.

But we must take heed of considering such gravity and levity as if they were Entities that work such effects: since upon examination, it appeareth that these words are but short expressions of the effects themselves: the causes whereof, the vulgar of mankind (who impose names to things) do not consider; but leave that work unto Philosophers to examine; whiles they onely observe, what they see done; and agree upon words to expresse that. Which words neither will in all circumstances alwayes agree to the same thing; for as cork doth descend in aire and ascend in water; so also will any other body descend if it lighteth among others more rare then it self, and will ascend if it lighteth among bodies that are more dense then it. And we term bodies light and heavy, onely according to the course, which we usually see them take.

Now proceeding further on; and considering how there are various degrees of density or gravity: it were irrationall to conceive, that all bodies should descend at the same rate, and keep equall pace with one another, in their journey downwards. For as two knives whereof one hath a keener edge then the other, being pressed with equall strength into like yielding matter, the sharper will cut deeper then the other: so, if of two bodies one be more dense then the other; that which is so, will cut the aire more powerfully, and will descend faster then the other: for in this case density may be compared to the knives edge, since in it consisteth the power of dividing; as we have heretofore determined. And therefore, the pressing them downwards by the descending atomes, being equall in both (or peradventure greater in the more dense body; as anon we shall have occasion to touch) and there being no other cause to determine them that way; the effect of division must be the greater, where the divider is the more powerfull. Which, the more dense body is; and therefore cutteth more strongly through the resistance of the aire; and consequently, passeth more swiftly that way it is determined to move.

I do not mean, that the velocities of their descent shall be in the same proportion to one another, as their densities are: for besides their density, those other considerations which we have discoursed of above when we examined the causes of velocity in motion, must likewise be ballanced. And out of the

7.
The more dense a body is, the more swiftly it descendeth.

8.
The velocity of bodies descending, doth not increase in proportion to the difference that may be between their severall densities.

comparison of all them; not out of the consideration of any one alone, resulteth the differences of their velocities: (and that neither, but in as much as concerneth the consideration of the moveables: for to make the calculation exact, the medium must likewise be considered; as by and by we shall declare) for since the motion dependeth of all them together; although there should be difference between the moveables in regard of one onely, and that the rest were equal; yet the proportion of the difference of their motions, must not follow the proportion of their difference in that one regard: because their difference considered single in that regard will have one proportion; and with the addition of the other considerations (though alike in both) to their difference in this, they will have another.

As for example, reckon the density of one moveable to be double the density of another moveable; so that in that regard it hath two degrees of power to descend, whereas the other hath but one: suppose then the other causes of their descent to be alike in both, and reckon them all three: and then joyn these three to the one which is caused by the density in one of the moveables, as likewise to the two, which is caused by the density in the other moveable: and you will find that thus altogether, their difference of power to descend is no longer in a double proportion (as it would be, if nothing but their density were considered) but is in the proportion of five to four.

But after we have considered all that concerneth the moveables, we are then to cast an eye upon the medium they are to move in; and we shall find the addition of that, to decrease the proportion of their difference, exceedingly more; according to the cessibility of the medium. Which if it be aire; the great disproportion of its weight, to the weight of those bodies which men use to take in making experiences of their descent in that yielding medium; will cause their difference of velocity in descending, to be hardly perceptible. Even as the difference of a sharp or dull knife, which is easily perceived in cutting of flesh or bread, is not to be distinguished in dividing of water or oyl. And likewise in weights, a pound and a scruple will bear down a dramme in no sensible proportion of velocity more then a pound alone would do: and yet put a pound in that scale in stead of the dramme, and then the

the difference of the scruple will be very notable. So then, those bodies, whose difference of descending in water is very sensible (because of the greater proportion of weight in water, to the bodies that descend in it) will yield no sensible difference of velocity when they descend in aire, by reason of the great disproportion of weight between aire & the bodies that descend in it

The reason of this will clearly shew it self in abstracted proportions. Thus; suppose aire to have one degree of density, and water to have 400; then let the moveable A have 410 degrees of density; and the moveable B have 500. Now compare their motion to one another in the severall mediums of aire and water. The exuperance of the density of A to water is 10 degrees, but the exuperance of B unto the same water, is 100 degrees; so that B must move in water swifter then A, in the proportion of 100 to tenne; that is, of 10 to one. Then let us compare the exuperance of the two moveables over aire. A is 409 times more dense then aire; but B is 499 times more dense then it. By which account, the motion of B, must be in that medium swifter then the motion of A, in the proportion of 499 to 409: that is, about 50, to 41: which (to avoid fractions) we may account as 10 to 8. But in water they exceed one another as 10 to one: so that their difference of velocity, must be scarce perceptible in aire in respect of what it is in water.

Out of all which discourse, I onely inferre in common, that a greater velocity in motion, will follow the greater density of the moveable; without determining here their proportions: which I leave unto them, who make that examination their task: for thus much serveth my present turn: wherein I take a survey of nature, but in grosse. And my chief drift in this particular is onely to open the way for the discovering how bodies that of themselves have no propension unto any determinate place; do neverthelesse move constantly and perpetually one way; the dense ones descending, and the rare ones ascending: not by any intrinsecall quality that worketh upon them; but by the oeconomy of nature, that hath set on foot due and plain causes to produce known effects.

Here we must crave patience of the great soul of Galileus (whose admirable learning all posterity must reverence) whiles we reprehend in him, that which we cannot term lesse then

9.
More or lesse
gravity doth
produce a swifter
or a slower

descending of
a heavy body.
Aristotles argu-
ment to dis-
prove motion
in vacuo, is
made good.

absurd : and yet, he not onely maintaineth it in severall places, but also professeth, Dial. Po. de motu pag. 81. to make it more clear then day. His position is, that more or lesse gravity contributeth nothing at all to the faster or slower descending of a naturall body : but that all the effect it giveth unto a body, is to make it descend or not descend in such a medium. Which is against the first and most known principle that is in bodies: to wit, that more doth more, and lesse doth lesse; for he alloweth, that gravity causeth a body to descend; and yet will not allow, that more gravity causeth it to descend more.

I wonder that he never marked how in a pair of scales, a superproportion of overweight in one ballance, lifted up the other faster then a lesse proportion of overweight would do. Or that more weight hanged to a jack, made the spit turn faster; or to the lines of a clock, made it go faster, and the like.

But his argument whereby he endeavoureth to prove his position, is yet more wonderfull: for finding in pendants unequal in gravity, that the lighter went in the same time almost as fast as the heavier; he gathereth from thence, that the different weights have each of them the same celerity: and that it is the opposition of the aire, which maketh the lighter body not reach so farre at each undulation, as the heavier doth. For reply whereunto; first, we must ask him whether experience or reason taught him, that the slower going of the lighter pendant, proceeded onely from the medium, and not from want of gravity? And when he shall have answered (as he needs must) that experience doth not shew this; then we must importune him for a good reason: but I do not find that he bringeth any at all.

Again; if he admitteth (which he doth in expresse terms) that a lighter body cannot resist the medium so much as a heavier body can, we must ask him, whether it be not the weight that maketh the heavier body resist more: which when he hath acknowledged that it is; he hath therein likewise acknowledged, that whensoever this happeneth in the descending of a body, the more weight must make the heavier body descend faster.

But we cannot passe this matter without noting how himself maketh good those arguments of Aristotle, which he seemeth by no means to esteem of: for since the gravity doth overcome the resistance of the medium in some proportion; it followeth, that the

the proportions between the gravity and the medium, may be multiplied without end; so as, if he suppose that the gravity of a body do make it go at a certain rate in imaginary space, (which is his manner of putting the force of gravity,) then there may be given such a proportion of a heavy body to the medium, as it shall go in such a medium at the same rate; and neverthelesse, there will be an infinite difference, betwixt the resistance of the medium compared to that body, and the resistance of the imaginary space compared to that other body which he supposeth to be moved in at the same rate: which no man will stick at confessing to be very absurd.

Then turning the scales, because the resistance of the medium doth somewhat hinder gravity, and that with lesse resistance, the heavy body moveth faster; it must follow, that since there is no proportion, betwixt the medium and imaginary space; there must neither be any proportion betwixt the time in which a heavy body shall passe through a certain quantity of the medium, & the time in which it shall passe through as much imaginary space: wherefore, it must passe over so much imaginary space in an instant. Which is the argument that Aristotle is so much laughed at for pressing. And in a word, nothing is more evident, then that, for this effect which Galileo attributeth to gravity, it is unreasonable to put a divisible quality, since the effect is indivisible. And therefore as evident it is that in his doctrine such equality, as intrinsecal gravity is conceived to be, ought not to be put: since every power should be fitted to the effect, or end for which it is put.

Another argument of Galileo is as bad as this; when he endeavoureth to prove that all bodies go of a like velocity, because it happeneth that a lighter body in some case, goeth faster then a heavier body in another case: as for example, in two pendants, whereof the lighter is in the beginning of its motion, and the heavier towards the end of it; or if the lighter hangeth at a longer string, and the heavier at a shorter; we see that the lighter will go faster then the heavier. But this concludeth no more, then if a man should prove that a lighter goeth faster then a heavier, because a greater force can make it go faster; for it is manifest that in a violent motion, the force which moveth a body in the end of its course, is weaker then that which moveth it in the beginning: and the like is, of the two strings. But

10.
The reason why at the inferior quarter of a circle, a body doth descend faster by the arch of that quarter, then by the chord of it.

But here it is not amisse to solve a Probleme he putteth which belongeth to our present subject. He findeth by experience, that if two bodies descend at the same time from the same point, and do go to the same point, the one by the inferior quarter of the circle; the other by the chord to that arch, or by any other lines which are chords to parts of that arch: he findeth (I say) that the moveable goeth faster by the arch, then by any of the chords. And the reason is evident, if we consider that the nearer any motion doth come unto a perpendicular one downwards, the greater velocity it must have; and that in the arch of such a quadrant, every particular part of it inclineth to the perpendicular of the place where it is, more then the part of the chord answerable unto it doth.

CHAP. XI.

An answer to objections against the causes of naturall motion, avowed in the former chapter; and a refutation of the contrary opinion.

I.
The first objection answered; why a hollow body descendeth slower then a solid one.

BUT to return to the thrid of our doctrine; there may peradventure be objected against it, that if the violence of a bodies descent towards the center, did proceed onely from the density of it (which giveth it an aptitude, the better to cut the medium) and from the multitude of little atomes descending that strike upon it, and presse it the way they go; which is downwards: then it would not import whether the inner part of that body were as solid as the ourward parts; for it cutteth with onely the outward, and is smitten onely upon the outward. And yet experience sheweth us the contrary: for a great bullet of lead, that is solid and lead throughout; descendeth faster then if three quarters of the diameter were hollow within; and such a one falling upon any resisting substance, worketh a greater effect then a hollow one. And a ball of brasse that hath but a thin outside of metall will swim upon the water, when a massive one sinketh presently. Whereby it appeareth, that it is rather some other quality belonging to the very bulk of the metall in it self; and not these outward causes that occasion gravity.

But this difficultie is easily overcome, if you consider how subtil those atomes are which descending downwards and striking

ing upon a body in their way, do cause its motion likewise downwards: for you may remember how we have shewed them to be the subtilest and the minutest divisions that *light*, the subtilest and sharpest divider in nature, can make. It is then easie to conceive that these extreme subtile bodies do penetrate all others, as light doth glasse; and do run through them, as sand doth through a small sieve, or as water through a sponge; so that they strike, not onely upon the superficies, but as well in every most interiour part of the whole body; running quite through it all, by the pores of it. And then, it must needs follow that the solidier it is; and the more parts it hath within (as well as without) to be strucken upon; the faster it must go, and the greater effect it must work in what it falleth upon: whereas if three quarters of the diameter of it within, should be filled with nothing but with aire; the atomes would fly without any considerable effect through all that space, by reason of the rarity and cessibility of it.

And that these atomes are thus subtile; is manifest by severall effects which we see in nature. Divers Authours that write of Egypt do assure us, that though their houses be built of strong stone; neverthelesse, a clod of earth laid in the inmost rooms, and shut up from all appearing communication with aire, will encrease its weight so notably, as thereby they can judge the change of weather, which will shortly ensue. Which can proceed from no other cause, but from a multitude of little atomes of saltpeter; which floating in the aire, do penetrate through the strongest walls, and all the massie defences in their way, and do settle in the clod of earth as soon as they meet with it; because it is of a temper fit to entertain, and to conserve, and to embody them. Delights have shewed us the way, how to make the spirits or atomes of snow & saltpeter passe through a glasse vessell; which Alchimitists hold to be the most impenetrable of all they can find to work with. In our own bodies; the aches which feeble parts do feel before change of weather, and the heaviness of our heads and shoulders, if we remain in the open aire presently after sunset; do abundantly testifie, that even the grosser of these atomes (which are the first that fall) do vehemently penetrate our bodies: so as, sense will make us believe, what reason peradventure could not.

But besides all this, there is yet a more convincing reason, why the

the descending atomes should move the whole density of a body; even though it were so dense that they could not penetrate it, and get into the bowels of it; but must be content to strike barely upon the outside of it. For nature hath so ordered the matter, that when dense parts stick close together, and make the length composed of them to be very stiff; one cannot be moved but that all the rest (which are in that line) must likewise be thereby moved: so that if all the world were composed of atomes close sticking together, the least motion imaginable must drive on all that were in a straight line, to the very end of the world: This you see is evident in reason, and experience confirmeth it, when by a little knock given at the end of a long beam, the shaking (which maketh sound) reacheth sensibly to the other end. The blind man that governeth his steps by feeling in defect of eyes, receiveth advertisements of remote things through a staff which he holdeth in his hands, peradventure more particularly than his eyes could have directed him. And the like is of a deaf man that heareth the sound of an instrument, by holding one end of a stick in his mouth, whiles the other end resteth upon the instrument. And some are of opinion (and they not of the rank of vulgar Philosophers) that if a staff were as long as to reach from the sunne to us, it would have the same effect in a moment of time. Although for my part I am hard to believe that we could receive an advertisement so farre, unlesse the staff were of such a thieknesse as being proportionable to the length might keep it from facile bending: for if it should be very pliant it would do us no service: as we experience in a thrid, which reaching from our hand to the ground, if it knock against any thing, maketh no sensible impression in our hand.

So that in fine, reason sense and authority do all of them shew us, that the lesse the atomes should penetrate into a moving body, by reason of the extreme density of it, the more efficaciously they would work, and the greater celerity they would cause in its motion. And hence we may give the fullest solution to the objection above, which was to this effect: that seeing division is made onely by the superficies or exterior part of the dense body; and that the virtue whereby a dense body doth work, is onely its resistance to division; which maketh it apt to divide: it would follow that a hollow bowl of brasse or iron should be as

bea-

heavie as a solide one. For we may answer, that seeing the atomes must strike through the body; and that a cessible body doth not receive their strokes so firmly as a stiffe one; nor can convey them so farre: if unto a stiffe superficies there succeed a yielding inside, the strokes must of necessity lose much of their force; and consequently, cannot move a body full of aire with so much celerity, or with so much efficacy as they may a solid one.

But then you may peradventure say, that if these strokes of the descending atomes upon a dense body, were the cause of its motion downwards, we must allow the atomes to move faster then the dense body; that so they may still overtake it and drive it along, and enter into it: whereas if they should move slower then it, none of them could come in their turn to give it a stroke, but it would be past them, and out of their reach before they could strike it. But it is evident (say you) out of these pretended causes of this motion, that such atomes cannot move so swiftly downwards, as a great dense bodie; since their littleness and their rarity, are both of them hindering to their motion: and therefore this cannot be the cause of that effect which we call gravity.

To this I reply; That to have the atomes give these blows to a descending dense body, doth not require that their naturall and ordinary motion should be swifter then the descent of such a dense body: but the very descent of it occasioneth their striking it; for as it falleth and maketh it self a way through them, they divide themselves before it, and swell on the sides and a little above it, and presently close again behind it and over it as soon as it is past. Now that closing to hinder vacuity of space is a sudden one, and thereby attaineth great velocity; which would carry the atomes in that degree of velocity further then the descending body, if they did not encounter with it in their way to retard them: which encounter and retarding implyeth such strokes upon the dense body as we suppose to cause this motion. And the like we see in water, into which letting a stone fall, presently the water that was divided by the stone, and swellett on the sides higher then it was before, closeth upon the back of the descending stone, and followeth it so violently, that for a while after it leaveth a purling hole in the place where the stone went down, till by the repose of the stone, the water returneth likewise to its quiet; and so its superficies becometh even. In

2.

The second objection answered, and the reasons shewn why atomes do continually overtake the descending dense body.

3.

A curious question left undecided.

In the third place, an enquiry occurreth emergent out of this doctrine, of the cause of bodies moving upwards and downwards. Which is, Whether there would be any naturall motion deep in the earth, beyond the activity of the sunnes beams? for out of these principles it followeth that there would not; and consequently there must be a vast orb in which there would be no motion of gravity or of levity: for suppose that the sunne beams might pierce a thousand miles deep into the body of the earth; yet there would still remain a masse, whose diameter would be near 5000 miles, in which there would be no gravitation nor the contrary motion.

For my part, I shall make no difficulty to grant the inference, as faire as concerneth motion caused by our sunne: for what inconvenience would follow out of it? But I will not offer at determining whether there may not be enclosed within that great sphere of earth, some other fire, (such as the Chymists talk of) an Archeus, a Demogorgon seated in the center, like the heart in animals, which may raise up vapours and boyl an aire out of them, and divide grosse bodies into atomes; and accordingly give them motions answerable to ours, but in different lines from ours, according as that fire or sunne is situated; since the farre-searching Authour of the Dialogues de Mundo, hath left that speculation undecided, after he had touched upon it in the twelfth knot of his first Dialogue.

4.

The fourth objection answered; Why the descent of the same heavy bodies is equall in to great inequality of the atomes which cause it.

Fourthly, it may be objected, that if such descending atomes as we have described were the cause of a bodies gravity, and descending towards the center; the same body would at divers times descend more and lesse swiftly; for example, after midnight when the atomes begin to descend more slowly; then likewise the same body would descend more slowly in a like proportion, and not weigh so much as it did in the heat of the day. The same may be said of summer and winter: for in winter time the atomes seem to be more grosse; and consequently to strike more strongly upon the bodies they meet with in their way as they descend: yet on the other side, they seem in the summer to be more numerous, as also to descend from a greater height; both which circumstances will be cause of a stronger stroke and more vigorous impulse upon the body they hit. And the like may be objected of divers parts

parts of the world, for in the torrid zone it will alwayes happen as in summer in places of the temperate zone; and in the polar climes as in deepest winter: so that no where there would be any standard or certainty in the weight of bodies, if it depended upon so mutable a cause. And it maketh to the same effect, that a body which lieth under a thick rock, or any other very dense body, that cannot be penetrated by any great store of atomes; should not be so heavy as it would be in the open and free aire, where the atomes in their complete numbers have their full strokes.

For answer to these and such like instances; we are to note first, that it is not so much the number or the violence of the percussion of the striking atomes, as the densitie of the thing stricken which giveth the measure to the descending of a weighty body: and the chief thing which the stroke of the atomes giveth unto a dense body, is a determination of the way which a dense body is to cut unto it self; therefore multiplication or lessening of the atomes, will not make any sensible difference betwixt the weight of one dense body where many atomes do strike, and an other body of the same densitie where but a few do strike; so that the stroke downwards of the descending atomes, be greater then the stroke upwards of the ascending atomes; and thereby determineth it to weigh to the centerwards, and not rise floating upwards, which is all the sensible effect we can perceive.

Next we may observe, that the first particulars of the objection, do not reach home to enfeeble our doctrine in this particular, although we admit them to be in such sort as they are proposed: for they do withall imply such a perpetual variation of causes, ever favourable to our position, that nothing can be inferred out of them to repugne against it. As thus: When there are many atomes descending in the aire, the same generall cause which maketh them be many, maketh them also be light in proportion to their multitude. And so, when they are few they are heavie; likewise when the atomes are light, the aire is rarified and thinne; and when they are heavie the aire is thick; and so upon the whole matter it is evident, that we cannot make such a precise and exact judgement

ment of the variety of circumstances, as to be able to determine when there is absolutely more cause of weight, and when lesse. And as we find not weight enough in either side of these opposite circumstances to turn the scales in our discourse, so likewise we find the same indifference in experience it self: for the weights we use do weigh equally in misty weather and in clear: and yet in rigour of discourse, we cannot doubt but that in truth they do not gravitate or weigh so much (though the difference be imperceptible to sense) when the aire is thick and foggy, as when it is pure and rarified: which thicknesse of the medium, when it arriveth to a very notable degree, as for example to water, maketh then a great difference of a heavie bodies gravitation in it; and accordingly we see a great difference between heavie bodies descending in water and in aire; though between two kinds of aire none is to be observed, their difference is so small in respect of the density of the body that descendeth in them: And therefore, seeing that an assured and certain difference in circumstances maketh no sensible inequality in the effect; we cannot expect any from such circumstances as we may reasonably doubt whether there be any inequality among them or no.

Besides that, if in any of the proposed cases a heavy body should gravitate more, and be heavier one time then another; yet by weighing it, we could not discern it; since that the counterpoise (which is to determine its weight) must likewise be in the same proportion heavier then it was, And besides weighing, no other means remaineth to discover its greater gravitation; but to compare it to time in its descent: and I believe that in all such distances as we can try it in, its inequalities will be no whit lesse difficult to be observed that way, then any other.

5.

Lastly, to bend our discourse particularly to that instance of the objection; where it is conceived that if gravity or descending downwards of bodies proceeded from atomes striking upon them as they move downwards; it would follow, that a stone or other dense body lying under shelter of a thick, hard, and impenetrable adamantine rock, would have no impulse downwards, and consequently would not weigh there. We may note, that no body whatsoever compacted by physicall causes and agents, can be so dense and imporous, but that

The reason why the shelter of a thick body doth not hinder the descent of that which is under it.

such

such atomes, as these we speak of, must be in them, and in every part of them, and every where passe through and through them; as water doth through a seive or through a sponge: and this universall maxime must extend as farre as the sunne, or as any other heat communicating with the sunne, doth reach and is found.

The reason whereof is, because these atomes are no other thing, but such extreme little bodies as are resolved by heat; out of the main stock of those masse bodies upon which the sun and heat do work. Now then it being certain, out of what we have heretofore said, that all mixt bodies have their temper and consistence, and generation from the mingling of fire with the rest of the Elements that compose them; and from the coction or digestion which fire maketh in those bodies: it is evident, that no mixt body whatsoever, nor any sensible part of a mixt body, can be void of pores capable of such atomes, nor can be without such atomes, passing through those pores; which atomes by mediation of the aire (that likewise hath its share in such pores) must have communication with the rest of the great sea of aire, and with the motions that passe in it. And consequently, in all and every sensible part, of any such extreme dense, and pretended impenetrable body, (to the notice whereof we can arrive) this percussion of atomes must be found; and they will have no difficulty in running through; nor by means of it, in striking any other body lying under the shelter of it; and thus both in & from, that hard body, there must be still an uninterrupted continuation of gravity or of descending towards the center.

Unto which we may adde, that the stone or dense body cannot lie so close to the rock that covereth it, but that some aire must be between, (for if nothing were between, they would be united, and become one continued body;) and in that aire (which is a creek of the great ocean of aire spread over the world, that is every where bestrewed with moving atomes; and which is continually fed, like a running stream, with new aire that driveth on the aire it overtaketh) there is no doubt but there are descending atomes, as well as in all the rest of its main body: and these descending atomes meeting with the stone, must needs give some stroke upon it; and that stroke (be it never so little) cannot chuse but work some effect, in making the stone remove a little that

way they go; and that motion, whereby the space is enlarged, between the stone and the sheltering rock, must draw in a greater quantity of aire and atomes to strike upon it. And thus by little and little, the stone passeth through all the degrees of tardity by which a descending body parteth from rest: which is by so much the more speedily done, by how much the body is more eminent in density. But this difference of time, in regard of the atomes strokes onely; and abstracting from the bodies density; will be insensible to us; seeing (as we have said) no more is required of them, but to give a determination downwards.

6.

The reason why some bodies sink, others swimme.

And out of this, we clearly see the reason why the same atomes, striking upon one body lying upon the water, do make it sink; and upon another they do not. As for example, if you lay upon the superficies of some water, a piece of iron, and a piece of cork, of equall bignesse and of the same figure; the iron will be beaten down to the bottome, and the cork will float at the top. The reason whereof is, the different proportions of the comparison of their densities with the densitie of water: for (as we have said) the efficacy and force of descending, is to be measured by that. So then the strokes of the atomes, being more efficacious upon water then upon cork, because the density of water is greater then the density of cork considering the abundance of aire that is harboured in the large pores of it; it followeth, that the atomes will make the water go down more forcibly then they will cork. But the density of iron exceeding the density of water; the same strokes will make the iron descend faster then the water; and consequently, the iron must sink in the water; and the cork will swimme upon it.

And this same is the cause, why if a piece of cork be held by force at the bottome of the water; it will rise up to the top of the water; as soon as the violence is taken away that kept it down: for the atomes strokes having more force upon the water then upon the cork; they make the water sink and slide under it; first, a little thinne plate of water; and then another, a little thicker; and so by degrees more and more, till it hath lifted the cork quite up to the top.

7.

The fifth objection answered concerning the

Fifthly, it may be objected, that these atomes do not descend *always* perpendicularly, but sometimes slopingly; and in that case, if their strokes be the cause of dense bodies moving, they should

should move sloping, and not downward. Now that these atomes descend sometimes slopingly, is evident, as when (for example) they meet with a stream of water, or with a strong wind, or even with any other little motion of the aire, such as carryeth feathers up and down hither and thither; which must needs waite the atomes in some measure along with them their way; seeing then that such a gentle motion of the aire is able to put a feather out of its way, notwithstanding the percussions of the atomes upon it; why shall it not likewise put a piece of iron out of its way downwards, since the iron hath nothing from the atomes but a determination to its way? But much more, why should not a strong wind, or a current of water, do it; since the atomes themselves that give the iron its determination must needs be hurried along with them?

descending of
heavy bodies
in streams.

To this we answer, that we must consider, how any wind or water which runneth in that sort, is it self originally full of such atomes; which continually, and every where, presse into it and cut through it, in pursuing their constant perpetuall course of descending; in such sort, as we shewed in their running through any hard rock, or other densest body. And these atomes do make the wind or the water primarily tend downwards; though other accidentall causes impell them secondarily to a sloping motion. And still, their primary naturall motion will be in truth strongest; though their not having scope to obey that, but their having enough to obey the violent motion, maketh this become the more observable. Which appeareth evidently out of this; that if there be a hole in the bottome of the pipe that conveyeth water slopingly, be the pipe never so long, and consequently the sloping motion never so forcible; yet the water will run out at that hole to obey its more powerfull impulse to the centerwards, rather than continue the violent motion, in which it had arrived to a great degree of celerity.

Which being so, it is easie to conceive that the atomes in the wind or water which move perpendicularly downwards, will still continue the irons motion downwards, notwithstanding the mediums sloping motion: since the prevailing force determineth both the iron, and the medium downwards; and the iron hath a superproportion of density to cut its way, according as the prevalent motion determineth it.

But if the descending atomes, be in part carried along down the stream by the current of wind or water; yet still the current bringeth with it new atomes into the place of those that are carried away; and these atomes, in every point of place wheresoever they are, do of themselves tend perpendicularly downwards; howbeit they are forced from the complete effect of their tendency, by the violence of the current: so that in this case they are moved by a declining motion, compounded of their own naturall motion, and of the forced motion, with which the stream carrieth them. Now then if a dense body do fall into such a current where these different motions give their severall impulses, it will be carried (in such sort as we say of the atomes; but in another proportion) not in a perpendicular but in a mixt declining line, compounded of the severall impulses, w^{ch} the atomes and the current do give it (in which also it is to be remembered, how the current giveth an impulse downwards, as well as sloping; and peradventure the strongest downwards;) and the declination will be more or lesse; according as the violent impulse prevaileth more or lesse against the naturall motion.

But this is not all that is to be considered in estimating the declination of a dense bodies motion when it is sinking in a current of wind or water; you must remember that the dense body it self hath a particular virtue of its own (namely its density) by which it receiveth and prosecuteth more fully its determination downwards; and therefore the force of that body in cutting its way through the medium, is also to be considered in this case, as well as above, in calculating its declining from the perpendicular; & out of all these causes will result a middle declination compounded of the motion of the water or wind both wayes, and of its own motion by the perpendicular line. And since of these three causes of a dense bodies motion, its own virtue in prosecuting by its density the determination it requireth, is the most efficacious by much after it hath once received a determination from without; its declination will be but little if it be very dense and heavie. But if it recede much from densitie, so as to have some near proportion to the densitie of the medium, the declination will be great. And in a word; according as the body is heavier or lighter, the declination will be more or lesse, in the same current through not exactly

exactly according to the proportion of the diminishing of its density, as long as there is a superproportion of its density to the medium: since that such a superproportion (as we have declared heretofore) maketh the mediums operation upon the dense body scarce considerable.

And hence you see why a stone or piece of iron, is not carried out of its way as well as a feather; because the stones motion downwards is greater and stronger then the motion of a feather downwards. And by consequence, the force that can return a feather from its course downwards, is not able to return a stone. And if it be replied, that it may be so ordered that the stone shall have no motion, before it be in the stream of a river, and notwithstanding it will still move downwards: we may answer, that considering the little declivity of the bed of such a stream, the strongest motion of the parts of the stream, must necessarily be downwards; and consequently, they will beat the stone downwards. And if they do not the like to a feather or other light body; it is because other parts of the stream, do get under the light body; and beat it upwards, which they have not power enough to do to the stone.

Sixthly, it may be objected, that if Elements do not weigh in their own spheres; then their gravity and descending must proceed from some other cause and not from this percussion of the atomes we attribute to it; which percussion we have determined goeth through all bodies whatsoever, and beateth upon every sensible part of them. But that Elements weigh not in their own spheres, appeareth out of the experience of a syphon; for though one leg of a syphon, be sunk never so much deeper into the body of the water, then the other leg reacheth below the superficies of the water: neverthelesse, if once the outward leg become full of water, it will draw it out of the other longer leg: which it should not do, if the parts of water that are comprised within their whole bulke, did weigh; seeing that the bulke of water is much greater in the sunk legge then in the other; and therefore these should rather draw back the other water into the cistern, then be themselves drawn out of it into the aire.

To this we answer, that it is evident the Elements do weigh in their own spheres; at least, as far as we can reach to their spheres:

8.

The sixth objection answered: and that all heavy elements do weigh in their own spheres.

for we see that a ballone stuffed hard with aire is heavier then an empty one. Again more water would not be heavier then lesse if the inward parts of it did not weigh : and if a hole were digged in the bottome of the sea, the water would not run into it and fill it, if it did not gravitate over it. Lastly, there are those who undertake to distinguish in a deep water, the divers weights which severall parts of it have, as they grow still heavier and heavier towards the bottome : and they are so cunning in this art, that they professe to make instruments which by their equality of their weight to a determinate part of the water, shall stand just in that part, and neither rise nor fall higher or lower: but if it be put lower, it shall ascend to its exact equally weighing orbe of the water ; and if it be put higher, it shall descend untill it cometh to rest precisely in that place. Whence it is evident, that parts of water do weigh within the bulk of their main body ; and of the like we have no reason to doubt, in the other two weighty Elements.

As for the opposition of the syphon, we referre that point to where we shall have occasion to declare the nature of that engine, of set purpose. And there we shall shew, that it could not succeed in its operation, unlessse the parts of water did gravitate in their main bulk, into which one leg of the syphon is sunk.

9. Lastly, it may be objected, that if there were such a course of atomes as we say; and that their strokes were the cause of so notable an effect, as the gravity of heavy bodies: we should feel it palpably in our own bodies, which experience sheweth us we do not.

To this we answer first, that their is no necessity we should feel this course of atomes, since by their subtilty they penetrate all bodies; and consequently, do not give such strokes as are sensible. Secondly, if we consider that dusts, and strawes, and feathers do light upon us without causing any sense in us; much more we may conceive that atomes (which are infinitely more subtile and light) cannot cause in us any feeling of them. Thirdly, we see that what is continuall with us, and mingled in all things doth not make us take any especiall notice of it : and this is the case of the smiting of atomes. Neverthelesse, peradventure we feel them in truth, as often as we feel hot and cold weather, and in all catarres or other such changes, which do as it were

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sink into our body without our perceiving any sensible cause of them: for no question but these atomes are the immediate causes of all good and bad qualities in the aire. Lastly, when we consider that we cannot long together hold out our arm at length, or our foot from the ground, and reflect upon such like impotencies of our resisting the gravity of our own body: we cannot doubt but that in these cases we feel the effect of these atomes, working upon those parts; although we cannot by our sense discern immediately that these are the causes of it.

But now it is time to draw our Reader out of a difficulty, which may peradventure have perplexed him in the greatest part of what he hath hitherto gone over. In our investigation of the Elements, we took for a principle thereunto: that gravity is sometimes more, sometimes lesse, then the density of the body in which it is. But in our explication of rarity and density; and again in our explication of gravity; we seem to put, that gravity and density is all one. This thorn I apprehend, may in all this distance, have put some to pain: but it was impossible for me to remedy it; because I had not yet delivered the manner of gravitation. Here then I will do my best, to assuage their grief, by reconciling these appearing repugnancies.

We are therefore to consider, that density (in it self) doth signifie a difficulty to have the parts of its subject, in w^{ch} it is, separated one from another; and that gravity (likewise in it self) doth signifie a quality, by which a heavy body doth descend towards the center; or (which is consequent thereunto) a force to make another body descend. Now this power, we have shewed, doth belong unto density, so far forth as a dense body being stricken by another, doth not yield by suffering its parts to be divided; but, with its whole bulk striketh the next before it, and divideth it, if it be more divisible then it self is. So that you see, density hath the name of density, in consideration of a passive quality or rather of an impassibility which it hath; and the same density is called gravity, in respect of an active quality it hath which followeth this impassibility. And both of them are estimated by the different respects which the same body or subject, in which they are, have unto different bodies that are the terms whereunto it is compared; for the active quality or gravity of a dense body, is esteemed by its respect to the body it striketh upon; whereas its

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How in the same body, gravity may be greater then density, and density then gravity; though they be the same thing.

density includeth a respect singly to the body that striketh it.

Now it is no wonder that this change of comparison worketh a disparity in the denominations: and that thereby the same body may be conceived to be more or lesse impartible, then it is active or heavy. As for example, let us of a dense Element take any one least part, which must of necessity be in its own nature and kind absolutely impartible: and yet it is evident that the gravity of this part must be exceeding little by reason of the littleness of its quantity; so that thus you see an extremity of the effect of density, joyned together in one body (by the accident of the littleness of it) with a contrary extremity of the effect of gravity, (or rather with the want of it) each of them within the limits of the same species. In like manner it happeneth, that the same body in one circumstance is more weighty, in another (or rather in the contrary) is more partible: so water when it is in a pail, because it is thereby hindered from spreading abroad hath the effect of gravity predominating in it; but if it be poured out, it hath the effect of partibility more. And thus it happeneth that merely by the gradation of rarity & density, one dense body may be apt, out of the generall course of naturall causes, to be more divisible then to be a divider; though according to the nature of the degrees considered absolutely in themselves, what is more powerfull to divide, is also more resistant and harder to be divided. And this arriveth in that degree which maketh water; for the falling and beating of the atomes upon water, hath the power both to divide it and to make it descend; but so, that by making it descend it divideth it. And therefore we say that it hath more gravity then density, though it be the very density of it, which is the cause that maketh it partible, by the working of one part upon another: for if the atomes did not find the body so dense as it is, they could not by their beating upon one part make another be divided.

So that a dense body to be more heavy then dense, signifieth nothing else, but that it is in such a degree of density, that some of its own parts by their being assisted & set on work by a generall cause (which is the fall of the atomes) are powerfull enough to divide other adjoining parts of the same density with them one from another; in such sort as we see that water poured out of an ewer into a basin where there is already other water, hath the power to divide the water in the basin by the assi-

stance of the celerity which it getteth in descending. And now I hope the reader is fully satisfied that there is no contradiction in putting *Density* and *Gravity* to be the same thing materially; and that neverthelesse the same thing may be more heavie then dense, or more dense then heavy, as we took it to our severall purposes in the investigation of the Elements.

Having thus laid an intelligible ground to discover how these motions that are generall to all bodies and are naturall in chief, are contrived by nature; we will now endeavour to shew that the contrary position is not onely voluntary, but also impossible. Let us therefore suppose that a body hath a quality to move it downwards. And first we shall ask what downwards signifieth: for either it signifieth towards a fixed point of imaginary space; or towards a fixed point of the universe; or towards some moveable point. As for the first, who would maintain it must have more imagination then judgement, to think that a naturall quality could have an essence determined by a nothing: because we can frame a conceit of that nothing. As for the second, it is very uncertain whether any such point be in nature: for as for the center of the earth, it is clear that if the earth be carried about, the center of it cannot be a fixed point. Again, if the center signifieth a determinate point in the earth that is the medium of gravity or of quantity, it is changed as often as any dust lighteth unequally upon any one side of the earth, which would make that side bigger then it was: and I doubt a quality cannot have morall considerations to think that so little doth no harm. As for the third position, likewise it is not intelligible how a quality should change its inclination or essence, according to the change that should light to make now one point, now another, be the center unto which it should tend.

Again, let us consider that a quality hath a determinate essence. Then seeing its power is to move, and to move signifieth to cut the medium it is moved in; it belongeth unto it of its nature to cut so much of such a medium in such a time. So that if no other cause be added but that you take precisely and *in abstracto*, that quality, that medium, & that time; this effect will follow, that so much motion is made. And if this effect should not follow it is clear, that the being able to cut so much of such a medium in such a time, is not the essence of this quality, as it was supposed to be. Dividing then the time & the medium, half the motion should

II.

The opinion of gravities being an intrinsecall inclination of a body to the center, refuted by reason.

be made in half the time, a quarter of the motion in a quarter of the time, and so without end, as farre as you can divide. But this is demonstratively impossible, sith hence it is demonstrated that a moveable coming from rest, must of necessity passe through all degrees of tardity; and therefore by the demonstration cited out of Galileus, we may take a part in which this gravity cannot move its body in a proportionate part of time, through a proportionate part of the medium.

12.

The same opinion refuted by severall experiments.

But because in naturall Theorems, experiences are naturally required; let us see whether nature giveth us any testimony of this verity. To that purpose we may consider a plummet hanging in a small string from a beam, which being lifted up gently on the one side at the extent of the string, and permitted to fall merely by the power of gravity, it will ascend very near as high on the contrary side, as the place it was held in from whence it fell. In this experiment we may note two things: the first, that if gravity be a quality, it worketh against its own nature in lifting up the plummet, seeing its nature is onely to carry it down. For though it may be answered, that it is not the gravity but another quality called *vis impressa* which carrieth it up: nevertheless it cannot be denied, but that gravity is either the immediate or at least the mediate cause which maketh this *vis impressa*: the effect whereof being contrary to the nature of gravity, it is absurd to make gravity the cause of it: that is, the cause of an essence, whose nature is contrary to its own. And the same argument will proceed though you put not *vis impressa*, but suppose some other thing to be the cause of the plummets remounting, as long as gravity is said to be a quality: for still gravity must be the cause of an effect contrary to its own inclination, by setting on foot the immediate cause to produce it.

The second thing we are to note in this experiment of the plummets ascent is, that if gravity be a quality, there must be as much resistance to its going up, as there was force to its coming down. Therefore there must be twice as much force to make it ascend, as there was to make it descend: that is to say, there must be twice as much force as the naturall force of the gravity is: for there must be once as much to equalize the resistance of the gravity; and then another time as much, to carry

it as farre through the same medium in the same time. But it is impossible that any cause should produce an effect greater then it self.

Again, the gravity must needs be in a determinate degree: and the virtue that maketh the plummet remount (whatsoever it be) may be put as little as we please: and consequently not able to oversway the gravity alone if it be an intrinsecall quality, and yet the plummet will remount: in which case you put an effect without a cause.

Another experience we may take from the force of sucking; for take the barrell of a long gun perfectly bored, and set it upright, with the breech upon the ground, and take a bullet that is exactly fit for it, but so as it stick not any where (both the barrell and it being perfectly polished;) and then if you suck at the mouth of the barrell (though never so gently) the bullet will come up so forcibly, that it will hazard the striking out of your teeth. Now let us consider what force were necessary to suck the bullet up, and how very slowly it would ascend, if in the barrell it had as much resistance to ascend, as in the free aire it hath inclination to go down. But if it had a quality of gravity naturall to it, it must of necessity have such resistance: whereas in our experiment we see it cometh as easily as the very aire. So that in this example as well as in the other, nature teacheth us that gravity is no quality.

And all or most of the arguments which we have urged against the quality of gravity in that explication we have considered it in, have force likewise against it, although it be said to be an inclination of its subject to move it self unto unity with the main stock of its own nature, as divers witty men do put it: for this supposition doth but change the intention or end of gravity: and is but to make it another kind of intellectuall or knowing Entity, that determineth it self to another end: which is as impossible for a naturall quality to do, as to determine it self to the former ends. And thus much the arguments we have proposed do convince evidently, if they be applied against this opinion.

CHAP. XII.

Of Violent Motion.

I.
The state of
the question
touching the
cause of violent
m.ot.on.

AND thus we have given a short scantling, whereby to understand in some measure the causes of that motion which we call naturall, by reason it hath its birth from the universall oeconomy of nature here among us; that is, from the generall working of the sunne, whereby all naturall things have their course: and by reason that the cause of it is at all times and in all places constantly the same. Next unto which the order of discourse leadeth us to take a survey of those forced motions, whose first causes the more apparent they are, the more obscurity they leave us in, to determine by what means they are continued

When a tennis-ball is stricken by a racket, or an arrow is shot from a bow, we plainly see the causes of their motion: namely the strings, which first yielding, and then returning with a greater celerity, do cause the missives to speed so fast towards their appointed homes. Experience informeth us what qualities the missives must be endued withall to move fast and steadily. They must be so heavy that the aire may not break their course; and yet so light, that they may be within the command of the stroke which giveth them motion; the striker must be dense, and in its best velocity: the angle which the missive is to mount by (if we will have it go to its furthest randome) must be the half of a right one: and lastly, the figure of the missive must be such, as may give scope unto the aire to bear it up, and yet not hinder its course by taking too much hold of it. All this we see; but when withall we see that the mover deserteth the moveable as soon as he hath given the blow; we are at a stand, and know not where to seek for that which afterwards maketh it flie: for motion being a transient, not a permanent thing, as soon as the cause ceaseth that begot it, in that very point it must be at an end; and as long as the motion continueth, there must be some permanent cause to make it do so: so that as soon as the racket or bowstring go back & leave the ball or arrow, why should not they presently fall straight down to the ground?

2.
That the medium is the cause
Aristotle and his followers have attributed the cause hereof to the aire: but Galileo relisheth not this conception. His arguments

ments against it, are (as I remember) to this tenour: first, aire by reason of its rarity and divisibility, seemeth not apt to conserve motion: next, we see that light things are best carried by the aire; and it hath no power over weighty ones: lastly, it is evident that aire taketh most hold of the broadest superficies; and therefore an arrow would flie faster broad-ways then long-ways, if this were true. Neverthelessse, since every effect must have a proportionable cause from whence it immediately floweth; and that a body must have another body to thrust it on as long as it moveth; let us examine what bodies do touch a moveable whilest it is in motion: as the onely means to find an issue out of this difficulty; for to have recourse unto a quality or impressed force for deliverance out of this straight, is a shift that will not serve the turn in this way of discourse we use. In this Philosophy no knot admitteth such a solution.

cause, which continueth violent motion.

If then we enquire what body it is that immediately toucheth the ball or arrow whilest it flieth; we shall find that none other doth so but the aire and the atomes in it, after the strings have given their stroke, and are parted from the missive. And although we have Galileos authority, and arguments to discourage us from believing that the aire can work this effect; yet since there is no other body besides it left for us to consider in this case, let us at the least examine how the aire behaveth itself after the stroke is given by the strings. First then it is evident that as soon as the racket or bow-string shrinketh back from the missive, and leaveth a space between the missive and it (as it is clear it doth, as soon as it hath stricken the resisting body) the aire must needs clap in with as much velocity as they retire, and with somewhat more; because the missive goeth forward at the same time, and therefore the aire must hasten to overtake it, least any vacuity should be left between the string and the arrow. It is certain likewise, that the aire on the sides doth also upon the division of it, slide back and help to fill that space which the departed arrow leaveth void. Now this forcible closing of the aire at the nock of the arrow, must needs give an impulse or blow upon it; if it seem to be but a little one, you may consider how it is yet much greater, then what the aire and the bodies swimming in it, do at the first give unto a stone falling from high: and how at the last those little atomes that drive a
stone:

stone in its naturall motion, do with their little blows force it peradventure more violently & swiftly then any impelling agent we are acquainted with can do. So that the impulse which they make upon the arrow, pressing violently upon it after such a vehement concussion, and with a great velocity, must needs cause a powerfull effect in that which of it self is indifferent to any motion any way.

3.

A further explanation of the former doctrine

But unlesse this motion of the aire do continue to beat still upon the arrow, it will soon fall to the ground, for want of a cause to drive it forward; and because the naturall motion of the aire (being then the onely one) will determine it downwards. Let us consider then how this violent rending of the aire by the blow that the bow-string giveth unto the arrow, must needs disorder the little atomes that swim to and fro in it, and that (being heavier then the aire) are continually descending downwards. This disorder maketh some of the heavier parts of them, get above others that are lighter then they; which they not abiding, do presse upon those that are next them, and they upon their fellows: so that there is a great commotion and undulation caused in the whole masse of aire round about the arrow: which must continue some time before it can be settled; and it being determined by the motion of the arrow that way that it slideth, it followeth that all this commotion and undulation of the aire, serveth to continue the arrow in its flight. And thus faster then any part behind can be settled, new ones before are stirred, till the resistance of the medium do grow stronger then the impulse of the movers.

Besides this, the arrow pressing upon the aire before it, with a greater velocity then the aire (which is a liquid rare body) can admit, to move all of a piece without breaking; it must of necessity happen that the parts of the aire immediately before the arrow be driven upon others further off, before these can be moved to give place unto them; so that in some places the aire becometh condensed, and consequently in others rarified. Which also the wind that we make in walking (which will shake a paper pinned loosely at the wall of a chamber towards which we walk) and the cooling aire caused by fanning when we are hot do evidently confirm. So that it cannot be doubted, but that condensation and rarefaction of the aire must necessarily follow the

the motion of any solid body: which being admitted it is evident that a great disorder, and for some remarkable time, must necessarily be in the aire; since it cannot brook to continue in more rarity or density then is naturall unto it. Nor can weighty and light parts agree to rest in an equall height or lownesse; which the violence of the arrows motion forceth them unto for the present. Therefore it cannot be denied, but that though the arrow slide away, nevertheless there still remaineth behind it (by this condensation and confusion of parts in the aire) motion enough to give impulse unto the arrow, so as to make it continue its motion after the bowstring hath left it.

But here will arise a difficulty: which is, how this clapping in and undulation of the aire should have strength and efficacy enough to cause the continuance of so smart a motion, as is an arrows shot from a bow. To this I need no other argument for an answer then to produce Galileos testimony, how great a body one single mans breath alone can in due circumstances give a rapid motion unto: and withall, let us consider how the arrow and the aire about it are already in a certain degree of velocity; that is to say, the obstacle that would hinder it from moving that way (namely, the resistance of the aire) is taken away; and the causes that are to produce it (namely the determining of the aires, and of the atomes motion that way) are heightened. And then we may safely conclude that the arrow which of it self is indifferent to be moved upwards or downwards, or forwards, must needs obey that motion which is caused in it by the atomes, and the aires pressing upon it; either according to the impulse of the string; or (when the string beginneth to flag) according to the beatings that follow the generall constitution of nature; or in a mixt manner according to the proportions that these two hold to one another. Which proportions Galileus in his 4. Dialogue of motion hath attempted to explicate very ingeniously: but having missed in one of his suppositions; to wit, that forced motion upon an horizontall line, is throughout uniform; his great labours therein have taken little effect towards the advancing the knowledge of nature; as he pretended: for his conclusions succeed not in experience, as Mersenius shureth us after very exact trials; nor can they in their reasons be fitted to nature.

So that to conclude this point; I find no difficulty in allowing
 this

4.

That the aire hath strength enough to continue violent motion in a moveable. Dial. 1. of motion pag. 98.

this motion of the aire strength enough to force the moveable onwards, for some time after the first mover is severed from it; (and long after, we see no motions of this nature do endure;) so that we need seek no further cause for the continuance of it: but may rest satisfied upon the whole matter, that since the causes and circumstances our reason suggesteth unto us, are after mature and particular examination proportionable to the effects we see, the doctrine we deliver must be found and true.

5.

An answer to the first objection; that aire is not apt to conserve motion. And how violent motion cometh to cease.

For the establishing whereof, we need not (considering what we have already laid) spend much time in solving Galileos arguments against it: seeing that, out of what we have set down, the answers to them appear plain enough; for first, we have assigned causes how the aire may continue its motion long enough to give as much impression as is needfull unto the arrow, to make it go on as it doth. Which motion is not requisite to be near so great in the aire behind the arrow (that driveth it on) as what the arrow causeth in the aire before it: for by reason of the density of it, it must needs make a greater impression in the aire it cutteth, then the aire that causeth its motion, would do of it self without the mediation of the arrow. As, when the force of a hand giveth motion unto a knife to cut a loaf of bread, the knife, by reason of the density and of the figure it hath, maketh a greater impression in the loaf, then the hand alone would do. And this is the same that we declared in the natural motion of a heaive thing downwards, unto which we assigned two causes; namely, the beating of the atomes in the aire, falling down in their naturall course, to determine it the way it is to go; and the density of the body, that cutting more powerfully then those atomes can do; giveth (together with their help) a greater velocity unto the moveable, then the atomes of themselves can give.

Nor doth it import that our resolution is against the generall nature of rare and dense bodies, in regard of conserving motion; as Galileo objecteth: for the reason why dense bodies do conserve motion longer then rare bodies, is, because in regard of their dividing virtue, they get in equall times a greater velocity. Wherefore seeing that velocity is equall unto gravity; it followeth, that resistance worketh not so much upon them as upon rare bodies; and therefore cannot make them cease from mo-

tion so easily as it doth rare bodies. This is the generall reason for the conservation of motion in dense bodies. But because in our case, there is a continuall cause which conserveth motion in the aire, the aire may continue its motion longer then of it self it would do: not in the same part of aire which Galileus (as it seemeth) did aim at: but in divers parts, in which the moveable successively is.

Which being concluded, let us see how the forced motion cometh to decrease and to be ended. To which purpose we may observe that the impression which the arrow receiveth from the aire that driveth it forwards, being weaker then that which it received at the first from the string, (by reason, that the aire is not so dense, and therefore cannot strike so great a blow) the arrow doth not in this second measure of time, (wherein we consider the impulse given by the aire onely) cut so strongly the aire before it, nor presse so violently upon it, as in the first measure when the string parting from it did beat it forwards: for till then the velocity encreaseth in the arrow, as it doth in the string that carrieth it along, which proceedeth from rest at the fingers loose from it, to its highest degree of velocity; which is, when it arriveth to the utmost extent of its jerk, where it quitteth the arrow. And therefore the aire now doth not so swiftly, nor so much of it, rebound back from before, and clap it self behind the arrow, to fill the space that else would be left void by the arrowes moving forward, and consequently the blow it giveth in the third measure, to drive the arrow on, cannot be so great as the blow was immediately after the strings parting from it; which was in the second measure of time: and therefore the arrow must needs move slower in the third measure then it did in the second; as formerly it moved slower in the second (which was the aires first stroke) then it did in the first, when the string drove it forwards. And thus successively in every moment of time, as the causes grow weaker & weaker by the encrease of resistance in the aire before, and by the decrease of force in the subsequent aire; so the motion must be slower & slower, till it come to pure cessation.

As for Galileus second argument; that the aire hath little power over heavy things; and therefore he will not allow it to be the cause of continuing forced motions in dense bodies: I wish he could as well have made experience what velocity of motion

6.

An answer to the second objection that the aire hath no power over heavey bodies.

a mans breath might produce in an heavie bullet lying upon an even, hard, & slippery plain, (for a table would be too short) as he did, how admirable great a one it produced in pendants hanging in the aire: and, I doubt not but he would have granted it as powerfull in causing horizontall motions, as he found it in the undulations of his pendants. Which neverthelesse, do sufficiently convince how great a power aire hath over heavie bodies. As likewise the experience of wind-guns assureth us that aire duly applied is able to give greater motion unto heavy bodies then unto light ones. For how can a straw or feather be imagined possibly to fly with half the violence as a bullet of lead doth out of one of those engines? And when a man sucketh a bullet upwards in a perfectly bored barrell of a gun, which the bullet fitteth exactly (as we have mentioned before) with what a violence doth it follow the breath and ascend to the mouth of the barrell? I remember to have seen a man that was uncautious and sucked strongly that had his foreteeth beaten out by the blow of the bullet ascending.

This experiment (if well looked into) may peradventure make good a great part of this doctrine we now deliver. For, the aire pressing in behind the bullet at the touch-hole, giveth it its impulse upwards; unto which the density of the bullet being added, you have the cause of its swiftness and violence; (for a bullet of wood or cork, would not ascend so fast and so strongly) and the sucking away of the aire before it, taketh away that resistance which otherwise it would encounter with by the aire lying in the way of it: & its following the breath with so great ease, sheweth (as we touched before) that of it self it is indifferent to any motion, when nothing presseth upon it to determine it a certain way.

7.
An answer to
the third objection,
that an
arrow should
fly faster broad-
wayes, then
longwayes.

Now to Galileos last argument; that an arrow should fly faster broadwayes, then longwayes, if the aire were cause of its motion: there needeth no more to be said, but that the resistance of the aire before, hindreth it as much as the impulse of the aire behind helpeth it on; so that nothing is gained in that regard; but much is lost, in respect of the figure; which maketh the arrow unapt to cut the aire so well when it flyeth broadwayes, as when it is shot longwayes: and therefore the aire being weakly cut, so much of it cannot clap in behind the arrow and drive it on, against the resistance before, which is much greater.

Thus far with due respect, and with acknowledging remem-

brance of the many admirable mysteries of nature which that great man hath taught the world, we have taken liberty to dispute against him: because this difficulty seemeth to have driven him against his Genius, to believe that in such motions there must be allowed a quality imprinted into the moved body to cause them: wch our whole scope both in this, and in all other occasions where like qualities are urged, is to prove them superfluous and ill grounded in nature; and to be but mere terms to confound & leave in the dark whosoever is forced to fly unto them.

CHAP. XIII.

Of three sorts of violent motion, Reflexion, Vndulation, and Refraction.

THe motion we have last spoken of, because it is ordinarily either in part or wholly contrary to gravity (which is accounted the naturall motion of most bodies) useth to be called violent or forced. And thus, you have delivered unto you the natures and causes both of naturall and of forced motion; yet it remaineth that we advertise you of some particular kinds of this forced motion, which seem to be different from it, but indeed are not. As first, the motion of reflexion: which if we do but consider how forced motion is made; we shall find that it is nothing else but a forced motion, whose line whereupon it is made, is as it were snapped in two by the encounter of a hard body. For even as we see in a spout of water that is strongly shot against a wall, the water following driveth the precedent parts first to the wall, and afterwards coming themselves to the wall, forceth them again another way from the wall: right so, the latter parts of the torrent of aire, which is caused by the force that occasioned the forced motion, driveth the former parts, first upon the resistant body, and afterwards again from it. But this is more eminent in light then in any other body, because light doth lesse resist gravity; and so observeth the pure course of the stroke, better then any other body; from which others do for the most part decline some way by reason of their weight.

Now the particular law of reflexion is, that the line incident, & the line of reflexion must make equal angles with that line of the resistant superficies wch is in the same superficies with themselves.

The demonstration whercof, that great wit Renatus Des Cartes

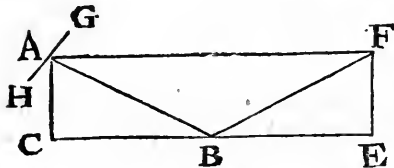
I.

That reflexion is a kind of violent motion.

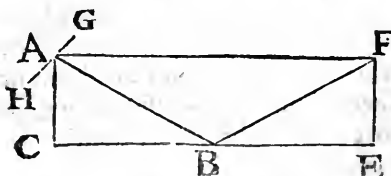
2.

Reflexion is made at equal angles.

hath excellently set down in his book of Dioptrikes by the example of a ball stricken by a racket against the earth, or any resisting body: the substance whereof is as followeth.



In the Rectangle Parallelogramme A E, let C E be the superficies of the earth: A, the point from which the racket H G, striketh the ball by the line A B, to the point B in the superficies of the earth: and let us consider C, to be on the left hand, and E on the right. Now we are to shew that the ball will rebound by the line B F, to the point F, in the same time in which it went from A to B; and so make the angle A B C equall to the angle F B E. For the effecting whereof, we must abstract, according to the manner of mathematicians, from all Physicall inequalities, and suppose the superficies C E, to be mathematically plain, and the force of the racket to continue equally strong in B as it is in A: for although in truth, neither of these be rigorously so; neverthelesse, because there is no sensible defect in any operation that dependeth on them, it is the same to our purpose as if they were mathematically so. We see then that the racket H G, doth in a certain time drive the ball from A to B; that is to say, from the left hand to the right, as farre as from C to B; and from above to downwards as farre as from A to C. We see again, that the superficies C E, is not contrary unto this motion of the ball, as it goeth from the left hand to the right; for the line C E lyeth likewise that way: but is contrary unto it, as it



goeth from above downwards; for in that course the superficies C E encountereth and putteth a period to the line A C. And therefore the motion of the ball when it meeteth with the superficies C E, must be changed from the line A C, so much as the superficies C E is contrary unto it; that is quite backwards as farre as it dependeth of that opposition. Therefore, when the ball is come to B, it must go from thence in the same proportion of left hand to right hand, and from below upwards, as it came before from left hand to right

hand, and from above downwards, when it came from A to B. And consequently, it must in equall time have passed another line from left hand to right hand, as long as the line CB; and likewise, it must at the same time have passed another line from below upwards as long as AC: which will of necessity make it hit in the point F, at the end of so much more time as it spent in going from A to B; and so, make the two angles ABC and FBE equall; as every one knoweth that hath but saluted Euclide.

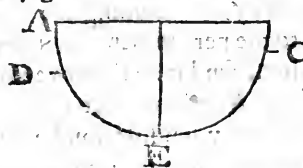
The motion which we call undulation needeth no further explication: for it is manifest, that since a pendant, when it is removed from its perpendicular, will restore it self thereunto by the naturall force of gravity, and that in so doing it gaineth a velocity, (and therefore cannot cease on a suddain,) it must needs be carried, out of the force of that motion, directly the contrary way: untill the force of gravity, overcoming the velocity it must be brought back again to the perpendicular: which being done likewise with velocity, it must send it again towards the place from which it fell at the first. And in this course of motion it must continue for a while, every undulation being weaker then other untill at last it quite ceaseth, by the course of nature settling the aire in its due situation according to the naturall causes that work upon it. And in this very manner also is performed that undulation which we see in water, when it is stirred from the naturall situation of its sphericall superficies.

Galileo hath noted that the time in which the undulations are made which follow one another of their own accord, is the same in every one of them; and that as much time precisely is taken up in a pendants going a very short arch towards the end of its vibration, as was in its going of the greatest arch at the beginning of its motion. The reason whereof seemeth strange to him, and he thinketh it to be an accident naturall to the body out of its gravity; and that this effect convinceth, it is not the aire which moveth such bodies. Whereas in truth, it is clearly the aire which causeth this effect. Because the aire striving at each end (where it is furthest from the force of the motion) to quiet it self, getteth at every bout somewhat upon the space; and so contracteth that into a shorter arch.

But it is a great wonder to me, that Galileo should make a

3.
The causes and
properties of
undulation.

wonder of this effect to the reason which he hath laid so fair a foundation upon another occasion, had he bur reflected upon it. For in his fourth dialogue of motion he hath demonstrated that a naturall moveable descending in the quarter of a circle, from what part soever it beginneth, spendeth equall time to come to the lowest point, as if it came from any other part: so that a pendant being brought up to any height by the force of a former motion downwards, it will be sure to spend as much time in going down from thence to the perpendicular, as it did at the first when it was let fall from the greatest height. Now I suppose, that the pendants ascending, being the effect of the velocity of its motion gained in descending immediately before; the said velocity must be able to carry it in the same time to a height, that is proportionate to that height unto which the velocity gained in the first fall did cause the pendant to mount. As



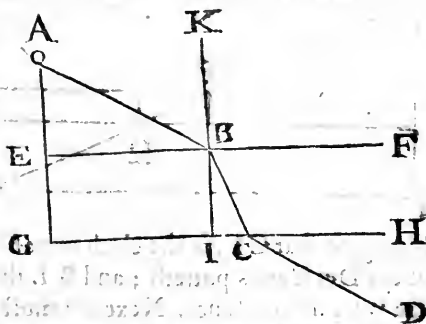
for example: if the pendants first descent were from A to E, the second from C to E; because the time of those two is the same, (as Galileus hath demonstrated) it followeth that their velocities gained in descending must of necessity be in the proportion of the line A E to the line C E: therefore, their effects also must be proportionable. Let us then put the line E D in that proportion to the line C E, which C E hath to A E, and then the velocity gained in C E will carry the pendant up from E to D, in the same time in which the descent A E did carry it up the other way from E to C: wherefore, seeing that the times of its descent from A to E, and from C to E are equall; likewise, the two vibrations from A to C and from C to D will be done in equall times. But that which made Galileo not see the force of the consequence, was that he did not acknowledge violent motion to be made in the same proportions, and for the same reasons which are found in naturall motion: which we have above shewed to be so, where we discoursed of that matter.

That motion also which we call *Refraction*, and is manifest to sense, onely in light; (though peradventure hereafter more diligent searchers of nature, may likewise find it in such other bodies as are called qualities; as in cold or heat, &c.) is but a kind

kind of Reflexion : for there being certain bodies, in which the passages are so well ordered with their resistances, that all the parts of them seem to permit light to passe through them, and yet all parts of them seem to reflect it ; when light passeth through such bodies, it findeth at the very entrance of them, such resistances where it passeth, as serve it for a reflectent body; and yet such a reflectent body, as hindereth not the passage through; but onely hindereth the passage from being in a straight line with the line incident. Wherefore the light must needs take a ply as beaten from those parts towards a line drawn from the illuminant, falling perpendicularly upon the resisting superficies; and therefore is termed by mathematicians, to be refracted or broken towards the perpendicular. Now at the very going out again of the light, the second superficies (if it be parallel to the former) must needs upon a contrary cause, strike it the contrary way: which is termed from the perpendicular.

towards the perpendicular; at the going out it is from it; when the second superficies is parallel to the first.

As for example: if the ray AB , lighteth upon the superficies EBF , and findeth entrance; it is not now the superficies EF , that resisteth or reflecteth it; but it is that part of the inside



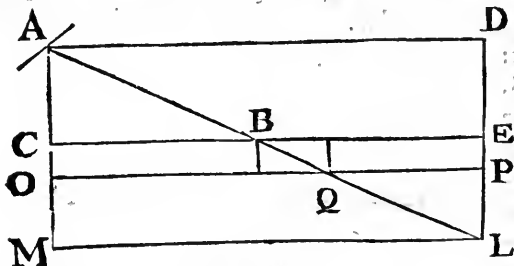
(as we may say) of the pore B , which is towards F ; and is a Physicall body, not a Mathematicall point. The reflexion therefore must be made, as if the reflectent body were IBK : but it is evident that if AB , did strike upon IK , it would reflect towards AG . But because we know not the inclination of the superficies IK , whether it be truly a perpendicular or no, therefore we cannot tell the quantity of the inclination which this reflexion must make; but onely we know that it must be towards AG .

But before we wade any deeper into this difficulty, we cannot omit a word of the manner of explicating refraction which Monsieur Des Cartes useth, so witty a one as I am sorry it wanteth successe. He therefore following the demonstration above

5.
A refutation of Monsieur Des Cartes his explication of refraction.

given of reflection; supposeth the superficies which a ball lighteth upon, to be a thin linen cloth, or some other such matter as will break cleanly by the force of the ball striking smartly upon it. And because that superficies resisteth onely one way, therefore he inferreth that the velocity of the ball is lessened onely one way & not the other: so that the velocity of its motion that way in which it findeth no resistance, must be (after the balls passage through the linen) in a greater proportion to the velocity w^{ch} it hath the other way where it findeth resistance, then it was before. And therefore the ball will in lesse time arrive to its period on the one side then on the other: and consequently, it will lean towards that side, unto which the course wherein it findeth no opposition doth carry it.

But how much he is mistaken upon the whole matter a little figure will shew: let us therefore put a Rectangle Parallelo-



gram as before A E, which I double & make the whole Parallelogram A L, & draw out the line A B, till it cometh to L. Now we must imagine that C E, is the cloth or passable superficies which Monsieur Des Cartes putteth; and B L the line it would go in, if there were no resistance. Next we must seek the perpendicular, which according to our explication, is A C: for that falleth from A the illuminant, perpendicularly upon C E; although, some who defend Monsieur Des Cartes, seem to make another line the perpendicular; against the conception of all those that write of Opticks. But, not to trouble our selves with terms; the question is, whether the ball that passeth the cloth, must (after its passage through) deflect from the line B L, (which it would have kept, had there been no resistance) towards E; or else deflect from that line towards C. And both experience and reason do assure us, that it must turn towards C: but Monsieur Des Cartes saith towards E.

Which to shew how it is contrary unto his own principle; let

us conceive the cloth C E to be of some thicknesse, and so draw the line O P to determine that thicknesse. And let us make from B upon A L, another Parallelogram like the Parallelogram A L, whose diameter shall be B Q. And it must necessarily follow that the motion from B to Q, if there were no resistance, were in the same proportion as from A to B. But the proportion of the motion from A to B, is the proportion of CB to CA; that is, it goeth in the same time faster towards D, then it doth towards M, in the proportion which CB hath to CA. By which account, the resistance it hath in the way towards D, must also be greater then the resistance it hath in the way towards M, in the proportion which CB hath to CA; and therefore the more tardity must be in the way to D, and not in the way to M; and consequently, the declination must be from E wards, and to M wards. For where there is most resistance, that way likewise must the tardity be greatest, & the declination must be from that way: but which way the thicknesse, to be passed in the same time, is most, that way the resistance is greatest: and the thicknesse is clearly greater towards E, then towards M; therefore, the resistance must be greatest towards E; & consequently the declination from the line BL must be towards M, and not towards E.

But the truth is, that in his doctrine the ball would go in a straight line as if there were no resistance; unless peradventure towards the contrary side of the cloth, at which it goeth out into the free aire: for as the resistance of the cloth is greater in the way towards D, then in the way towards M, (because it passeth a longer line in the same time, as also it did formerly in the aire) so likewise is the force that moveth it that way greater then the force which moveth it the other. And therefore the same proportions that were in the motion, before it came to the resisting passage, will remain also in it: at the least untill coming near the side at which it goeth out, the resistance be weakned by the thinnesse of the resistant there: which because it must needs happen on the side that hath least thicknesse, the ball must consequently turn the other way, where it findeth greatest yielding: and so at its getting out into the free aire, it will bend from the greater resistance, in such manner as we have said above.

Neither do the examples brought by Monsieur Des Cartes and others in maintenance of this doctrine any thing avail

An answer to
the arguments
brought in fa-
vour of Mon-
sieur Des Car-
tes his opinion.

them: for when a canon bullet shot into a river, hurteeth the people on the other side; it is not caused by refraction, but by reflection, as Monsieur Des Cartes himself acknowledgeth: and therefore, hath no force to prove any thing in refraction; whose laws are divers from those of pure reflexion.

And the same answer serveth against the instance of a musket bullet shot at a mark under water; which perpetually lighteth higher then the mark, though it be exactly just aimed at. For we knowing that it is the nature of water, by sinking in one place to rise round about, it must of necessity follow that the bullet which in entring hath pressed down the first parts of the water, hath withall thereby put others further off in a motion of rising: and therefore the bullet in its going on must meet with some water swelling upwards, & must from it receive a ply that way, which cannot fail of carrying it above the mark it was levelled at. And so we see this effect proceedeth from reflection or the bounding of the water, and not from refraction. Besides that, it may justly be suspected the shooter took his aim too high, by reason of the marks appearing in the water higher then in truth it is: unlesse such false aiming were duly prevented.

Neither is Monsieur Des Cartes his excuse to be admitted, when he saith that light goeth otherwise then a ball would do, because that in a glasse or in water, the etheriall substance which he supposeth to run through all bodies, is more efficaciously moved then in aire: and that therefore light must go faster in the glasse then in the aire, and so turn on that side of the straight line which is contrary to the side that the ball taketh, because the ball goeth not so swiftly. For (not to dispute of the verity of this proposition) the effect he pretendeth is impossible: for if the etheriall substance in the aire before the glasse be slowly moved, (the motion of which he calleth light) it is impossible that the etheriall substance in the glasse or in the water should be more smartly moved then it. Well it may be lesse; but without all doubt the impulse of the etheriall substance in the glasse cannot be greater then its adequate cause, which is the motion of the other parts that are in the aire precedent to glasse.

Again, after it is passed the glasse, it should return to be a straight line with the line that it made in the aire precedent to the glasse: seeing that the subsequent aire must take off just as much (and no more) as the glasse did adde: the contrary where-

Thirdly, in this explication it would alwayes go one way in the aire, and another way in the glasse: whereas all experience testifieth, that in a glasse convex on both sides, it still goeth in the aire after its going out to the same side as it did in the glasse; but more. And the like happeneth in glasses on both sides concave. Wherefore it is evident, that it is the superficies of the glasse that is the worker on both sides; and not the substance of the aire on the one side, and of the glasse on the other.

And lastly, his answer doth no way solve our objection, which proveth that the resistance both wayes is proportionate to the force that moveth, and by consequence that the thing moved must go straight. As we may imagine would happen if a bullet were shot sloping through a green mud wall, in which there were many round sticks so thin set that the bullet might passe with ease through them; for as long as the bullet touched none of them (which expresseth his case) it would go straight; but if it touched any of them (which resembleth ours, as by and by will appear) it would glance according to the quality of the touch, and move from the stick in another line.

Some peradventure may answer for Monsieur Des Cartes that this subtile body which he supposeth to run through all things is stiffe and no wayes pliable. But that is so repugnant to the nature of rarity & so many insuperable inconveniencies do follow out of it; as I cannot imagine he will own it; and therefore I will not spend any time in replying thereunto.

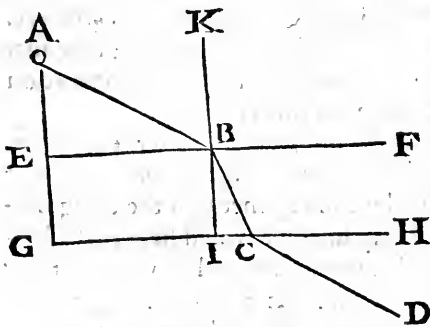
We must therefore seek some other cause of the refraction of light, which is made at the entrance of it into a diaphanous body. Which is plainly (as we said before) because the ray striking against the inside of a body it cannot penetrate, turneth by reflexion towards that side on which the illuminant standeth; and if it findeth clear passage through the whole resistant, it followeth the course it first taketh; if not, then it is lost by many reflections to and fro.

And that this doctrine is true, the accidents or Phenomenas evidently declare unto us; for experience teacheth us, that upon a plain superficies the refraction is made towards the perpendicular drawn from the illuminant to the superficies; as we have said. Now at the going out (if the surfaces be parallels) we see that the ray turneth from that perpendicular; which also is necessary:

7.

The true cause of refraction of light both at its entrance, & at its going out from the reflecting body.

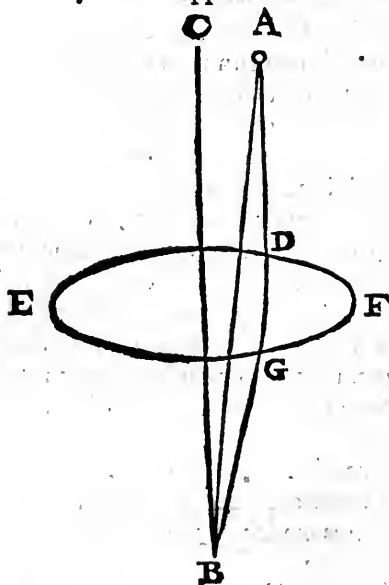
cessary; for going through a pore bigger then it self, or at the least as big; and finding it full of aire, it must needs be crowded there. But in a crowd, he presseth you most who you presse most upon: so then that side of the pore which is next to the light as it



passeth, must presse most upon it: but the angle w^{ch} is towards the perpendicular, to wit, the angle B C I, is the lesser; & by consequence, the ray is nearer that side of the pore which is towards I, then the other side of it w^{ch} is towards H; where-

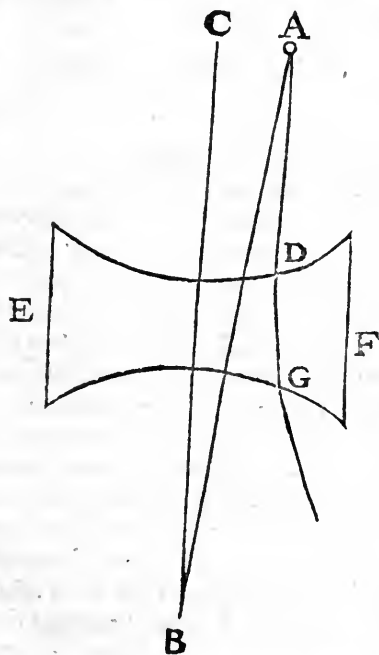
fore it must take its ply from that side. But that side striketh it from the perpendicular; and therefore it must there refract from the perpendicular.

This very same doctrine for the reason of refraction is confirmed by what happeneth in crooked superficieses. As if E F



be a *Lens* or a glasse on both sides convex; and C B the axis of it; A D the ray falling from the illuminant A; A B the perpendicular falling frō the same illuminant A: it will be plain by the former discourse, that the ray A D, must at the entry be refracted towards A B, as being repulsed from that part of the inside of the pore D, which is towards F; because that side is most opposed unto the ray. Now the ray being once turned that way; when at the end of its journey through the glasse

glasse, it is come to the other superficies EGF, it maketh the lesser angle towards F; and therefore must it by the rule given above be refracted again at its parting from the glasse, towards the same perpendicular; and it will meet somewhere with the axis CB; all which experience sheweth us to be true.



And taking a body of concave surfaces we shall (according to this doctrine of ours) find the causes of refraction just contrary; & accordingly experience likewise sheweth us the effects to be so too. And therefore since experience agreeth exactly with our rules, we cannot doubt but that the principles upon which we go are well laid.

But because crooked surfaces may have many irregularities; it will not be amisse to give a rule by which all of them may be brought unto a certainty. And this it is, that reflexions from crooked

8.

A generall rule to know the nature of reflexions and refractions in all sorts of surfaces.

superficiēs are equal to the reflexions that are made from such plain superficieses, as are tangents to the crooked ones in that point from whence the reflexions are made. Which principle the masters of Opticks do take out of a Mathematicall supposition of the unity of the reflecting point, in both the surfaces; the crooked and the plain: but we take it out of the insensibility of the difference of so little a part in the two different surfaces, as serveth to reflect a ray of light: for where the difference is insensible in the causes, there likewise the difference is so little in the effects, as sense cannot judge of them: which is as much as is requisite to our purpose. Now seeing that in the Mathematicall supposition, the point where the reflexion is made is in-

different

different to both the surfaces: it followeth, that it importeth not whether superficies you take to know the quality of reflexion by. This principle then being settled, that the reflexion must follow the nature of the tangent surfaces, and it being proved, that in plain surfaces it will happen in such sort as we have explicated, it followeth that in any crooked superficies of what figure soever the same also will happen.

Now seeing we have formerly declared, that refractions are but a certain kind of reflexions, what we have said here of reflexions may be applyed to refractions.

9. But there remaineth yet untouched one affection more of refractions; which is that some diaphanous bodies do in their inward parts reflect more then others, (which is that which we call refraction) as experience sheweth us: concerning which effect, we are to consider that diaphanous bodies may in their composition have two differences: for some are composed of greater parts and greater pores; others, of lesser parts and lesser pores. It is true there may be other combinations of pores and parts, yet by these two the rest may be esteemed. As for the first combination, we see that because the pores are greater, a greater multitude of parts of light may passe together through one pore; and because the parts are greater, likewise a greater multitude of rayes may reflect from the same part, and may find the same passage quite throughout the diaphanous body. On the contrary side in the second combination where both the pores and the parts of the diaphanous body are little, the light must be but little that findeth the same passage.

A body of greater parts and greater pores maketh a greater refraction then one of lesser parts and lesser pores.

Now that refraction is greater or lesser happeneth two wayes: for it is either when one diaphanous body reflecteth light at more angles then another, and by consequence in a greater extent of the superficies; or else when one body reflecteth light from the same point of incidence in a shorter line & in a greater angle then another doth. In both these wayes it is apparent that a body composed of greater parts and greater pores, exceedeth bodies of the opposite kind: for by reason that in the first kind more light may beat against one part; a body in which that happeneth, will make an appearance from a further part of its superficies: whereas in a body of the other sort, the light that beateth against one of the little parts of it will be so little as it will

will presently vanish. Again, because in the first, the part at the incidence is greater; the surface from which the reflexion is made inwards, hath more of a plain and straight superficies: and consequently doth reflect at a greater angle, then that, whose superficies hath more of inclining.

But we must not passe from this question, without looking a little into the nature of those bodies in which refraction is made: for if they, as well as the immediate causes of refraction, do likewise favour us; it will not a little advance the certainty of our determination. To this purpose we may call to mind, how experience sheweth us that great refractions are made in smoke, and in mists, and in glasses, and in thick-bodied waters; and Monsieur Des Cartes addeth certain oyles, and spirits or strong waters.

Now most of these we see are composed of little consistent bodies, swimming in another liquid body. As is plain in smoke and mists: for the little bubbles which rise in the water before they get out of it; and that are smoke when they get into the aire; do assure us that smoke is nothing else, but a company of little round bodies, swimming in the aire: and the round consistence of water upon herbs, leas, and twigs in a rind or dew, giveth us also to understand that a mist is likewise a company of little round bodies that sometimes stand, sometimes float in the aire, as the wind driveth them. Our very eyes bear witness to us, that the thicker sort of waters are full of little bodies, which is the cause of their not being clear.

As for glasse, the blowing of it convinceth, that the little darts of fire which pierce it every way, do naturally in the melting of it convert it into little round hollow bodies, which in their cooling must settle into parts of the like figure. Then for crystal and other transparent stones which are found in cold places; it cannot be otherwise, but that the nature of cold piercing into the main body, and contracting every little part in it self, this contraction must needs leave vacant pores between part and part. And that such transparent stones as are made by heat, have the like effect and property, may be judged out of what we see in bricks and tiles, which are left full of holes by the operation of the fire. And I have seen in bones that have lain a long time in the sun, a multitude of sensible little pores close to one another, as if they had been formerly stuck all over with

IO.

A confirmation of the former doctrine, out of the nature of bodies that refract light.

with subtiler sharp needles as close as they could be thrust in by one another. The Chymicall oyles and spirits which Monsieur Des Cartes speaketh of, are likely to be of the same composition; since that such use to be extracted by violent fires: for a violent fire is made by the conjunction of many rayes together; and that must needs cause great pores in the body it worketh upon; and the sticking nature of these spirits, is capable of conserving them

Out of all these observations, it followeth, that the bodies in which greatest refractions do happen, are compounded (as we have said) of great parts, and great pores. And therefore, by only taking light to be such a body as we have described it to be, where we treated of the nature of it; it is evident, that the effect which we have expressed, must necessarily follow by way of reflexion, and that refraction is nothing else but a certain kind of reflexion

Which last assertion, is likewise convinced out of this; that the same effects proceed from reflexion as from refraction: for by reflection a thing may be seen greater then it is; in a different place from the true one where it is: colours may be made by reflexion, as also glowing light; and fire likewise; and peradventure all other effects which are caused by refraction, may as well as these, be performed by reflexion. And therefore it is evident, they must be of the same nature; seeing that children are the resemblances of their parents.

CHAP. XIV.

Of the composition, qualities, and generation of mixed bodies.

I.
The connexion
of this chapter
with the rest,
and the Au-
thors intenc
in.

HAVING now declared the virtues by which fire and earth work upon one another, and upon the rest of the elements; which is, by light, and by the motions we have discoursed of. Our task shall be in this chapter first to observe what will result out of such action of theirs: and next, to search into the wayes and manner of compassing and performing it. Which latter we shall the more easily attain unto, when we first know the end that their operation levelleth at. In this pursuit we shall find that the effect of the elements combinations, by means of the motions that happen among them; is a long pedigree of compounded qualities and bodies: wherein the first combinations (like marriages) are the breeders of the next more composed substances: and they again are the parents of others in greater variety:

variety : and so are multiplied without end ; for the further this work proceedeth, the more subjects it maketh for new businessse of the like kind.

To descend in particular unto all these, is impossible. And to looke further then the generall heads of them, were superfluous and troublesome in this discourse ; wherein I aime onely at shewing what sorts of things in common, may be done by bodies : that if hereafter we meet with things of another nature and strain, we may be sure they are not the offspring of bodies and of quantity ; which is the main scope of what I have designed here. And to do this with confidence and certainty, requireth of necessity this leisurely and orderly proceeding that hitherto we have used, and shall continue to the end : for walking thus softly ; we have alwayes one foot upon the ground ; so as the other may be sure of firm footing before it settle. Whereas, they that for more hast will leap over rugged passages and broken ground ; when both their feet are in the aire, cannot help themselves, but must light as chance throweth them.

To this purpose then we may consider, that the qualities of bodies in common are of three sorts : for they are belonging either to the constitution of a compounded body, or else to the operation of it ; and the operation of a body, is of two kinds ; the one, upon other bodies, the other, upon sense. The last of these three sorts of qualities, shall be handled in a peculiar chapter by themselves. Those of the second sort, whereby they work upon other bodies, have been partly declared in the former chapters, and will be further discoursed of in the rest of this first Treatise : so as that which remaineth for the present, is to fall upon the discourse of such qualities as concur to the constitution of bodies ; with an aime to discover, whether (or no) they may be effected by the severall mixtures of rarity and density, in such sort as is already declared. To which end, we are to consider in what manner these two primary differences of bodies may be joyned together : and what effects such conjunction will produce.

As for their conjunction : to deliver the nature of it entirely, we must begin from the very root of it ; and consider how the Universe being finite (which Mr. White hath demonstrated in the second knot of his first Dialogue) there cannot be an infinite number of bodies in it ; for Geometricians shew us how the least

2.
That there is a least size of bodies, and that this least size is found in fire.

quantity that is, may be repeated so often as would exceed any the greatest determinate quantity whatsoever. Out of which it followeth, that although all the other bodies of the world were no bigger then the least quantity that can be designed; yet they being infinite in number, would be greater then the whole universe that containeth them. And therefore, of necessity there must be some least body, or rather, some least size of bodies: which in compounded bodies is not to be expected: for, their least parts being compounded, must needs include compounding parts lesse then themselves. We must then look for this least size of bodies in the Elements; which of all bodies are the simplest. And among them, we must pitch upon that, wherein is greatest divisibility, and which consequently is divided into least parts; that is, fire: so as we may conclude that among all the bodies in the world, that which of its own nature hath an aptitude to be least, must be fire.

3.
The first conjunction of parts is in Bodies of least size; and it is made by the force of Quantity.

Now, the least body of fire, be it never so little, is yet divisible into lesse. What is it then that maketh it be one? To determine this; we must resort unto the nature of *Quantity*: whose formall notion and essence is, *To be divisible*; which signifieth, that many may be made of it; but that of which many may be made, is not yet many, out of this very reason, that many may be made of it. But, what is not many, is one. Therefore what hath quantity; is, by mere having quantity, actually and formally as well one, as it hath the possibility of being made many. And consequently, the least body of fire, by having quantity, hath those parts which might be many, actually one. And this is the first conjunction of parts that is to be considered in the composition of bodies: w^{ch} though it be not an actuall joyning of actuall parts; yet it is a formal cōjunction of what may be many.

4.
The second sort of conjunction is compoundedness in simple Elements, and it proceedeth from density.

In the next place we may consider; how seeing the least bodies that are, be of fire; it must needs follow, that the least parts of the other Elements must be bigger then they. And consequently, the possible parts of those least parts of the other Elements must have something to conserve them together, more then is found in fire. And this, because Elements are purely distinguished by rarity and density is straight concluded to be *density*. And thus we have found; that as quantity is the cause of the possible parts being one, so density is the cause of the like parts sticking

toge-

together: which appeareth in the very definition of it, for, *to be lesse divisible*, (which is the notion of density) speaketh a resistance to division, or a sticking together.

Now let us examine how two parts of different Elements are joyned together, to make a compound. In this conjunction we find both the effects we have already touched: for, two such parts must make one; and moreover, they must have some resistance to divisibility. The first of these effects we have already assigned unto the nature of quantity. And it being the formall effect of quantity; it cannot (wheresoever it is found) have any other formall cause then quantity: and therefore either the two little parts of different Elements, do not become one body: or if they do, we must agree that it is by the nature of quantity which worketh as much in heterogeneall parts, as it doth in homogeneall ones. And it must needs do so: because Rarity and Density (which are the proper differences of Quantity) cannot change the common nature of Quantity, that is their Genus: which by being so to them, must be univocally in them both. And this effect cometh precisely from the pure notion of the Genus: and consequently, must be seen as well in two parts of different natures, as in two parts of the same nature: but in parts of the same nature, which once were two, and afterwards become one; there can be no other reason why they are one, then the very same for which those parts that were never separated (but that may be separated) are likewise one: and this, most evidently, is the nature of quantity.

Experience seemeth to confirm thus much; when pouring water out of a basin, some of it will remain sticking to the sides of the metall: for if the quantity of the basin, and of the water, had not been one and the same by its own nature; the water (considering the pliability of its parts) would certainly have comen all away, and have glided from the unevenness of the basin, by the attractive unity of its whole, and would have preserved the unity of its quantity within it self, rather then by sticking to the basin, have suffered division in its own quantity; which we are sure was one, while the water was altogether in the basin: but that, both the basin and the water making but one quantity; and a division being unavoydable in that one quantity; it was indifferent, in regard of the quantity considered singly

5.
The third conjunction is of parts of different Elements, and it proceedeth from quantity and density together.

by it self, where this division should be made, whether in the parts of the basin, or in the parts of the water: and then, the other circumstances determined it in that part of the water which was nearest to the joyning of it with the basin.

The second effect (which was resistance to divisibility;) we assigned unto density. And of that same cause, must also depend the like effect in this case of the sticking together of the two parts of different Elements, when they are joyned to one another: for if the two parts, whereof one is dense, the other is rare, do not exceed the quantity of some other part of one homogeneous rare Element for the dividing whereof, such a determinate force, and no lesse can suffice: then, seeing that the whole composed of these two parts is not so divisible as the whole consisting of that one part; the assigned force will not be able to divide them. Wherefore it is plain, that if the rare part had been joyned to another rare part instead of the dense one it is joyned unto, it had been more easily dividable from that, then now it is from the dense part. And by consequence it sticketh more closely to the dense part, then it would to another of its own nature.

6.

The reason why liquid bodies do easily joyne together; and dry ones difficultly.

Out of what we have said, a step is made us to understand why soft and liquid bodies do easily joyne and incorporate into one continued body; but hard and dry bodies so difficultly, as by experience we find to be true. Water with water, or wine either with other wine or with water, so uniteth, that it is very hard to part them: but sand or stones cannot be made to stick together without very great force and industry. The reasons whereof, must necessarily depend of what we have said above. To wit, that two bodies cannot touch one another, without becoming one: and, that if two bodies of one degree of density do touch, they must stick together according to the force of that degree of density. Out of which two, is manifestly inferred, that if two hard things should come to touch, they must needs be more difficultly separated then two liquid things. And consequently, they cannot come to touch, without as much difficulty, as that whereby they are made one.

7.

That no two hard bodies can touch one another immediately.

But to deduce this more particularly; let us consider, that all the little surfaces, by which one hard body may be conceived to touch another (as for example, when a stone lieth upon a stone) must of necessity be either plain, or concave, or convex. Now if

if a plain superficies should be supposed to touch another plain one coming perpendicularly to it; it must of necessity be granted to touch it as soon in the middle as on the sides. Wherefore, if there were any aire (as of necessity there must be) betwixt the two surfaces before they touched; it will follow, that the aire which was in the middle must have fled quite out from between the two surfaces, as soon as any part of the surfaces do touch; that is, as soon as the aire which was between the utmost edges of the surfaces did fly out; and by consequence it must have moved in an instant.

But if a plain surface be said to touch a convexe surface; it toucheth it onely by a line, (as Mathematicians demonstrate) or onely by a point. But, to touch by a line or a point, is in truth, not to touch by the form or notion of Quantitie, which requirerh divisibilitie in all that belongeth unto it;) and by consequence among bodies it is not to touch; and so, one such surface doth not touch the other.

Now, for a plain surface to touch a concave, every man seeth is impossible. Likewise for to convexe surfaces to touch one another, they must be allowed to touch either in a line or in a point, which we have shewed not to be a physicall touching. And if a convexe surface should be said to touch a concave; they must touch all at once as we said of plain surfaces; and therefore the same impossibility will arise therein: so that it is evident, that no two surfaces moving perpendicularly towards one another, can come to touch one another, if neither of them yieldeth, and changeth its hew.

Now then, if it be supposed that they come slidingly one over another in the same line; whereby, first the very tips of the edges come to touch one another; and still as you shoove the upermost on forwards, and that it slideth over more of the nether surface, it gaineth to touch more of it. I say that neither in this case do they touch immediately one another; for as soon as the two first parts should meet, if they did touch, and that there were no aire between them; they must presently become one quantity or body as we have declared; and must stick firmly together, according to their degree of density; and consequently could not be moved on without still breaking asunder at every impulse, as much of the massie body, as were already made one by their touching.

And if you should say they did not become one; and yet allow them to touch immediately one another without having any aire or fluide body between them; then if you suppose them to move onwards upon these termes; they would be changed locally, without any intrinsecall change: which in the book *De Mundo* (as we have formerly alledged) is demonstrated to be impossible.

There remaineth onely a third way for two hard surfaces to come together; which is, that first they should rest sloping one upon another, and make an angle where they meet (as two lines, that cut one another, do in their point of their intersection) and so contain as it were a wedge of aire between them; which wedge they should lessen by little and little, through their moving towards one another at their most distant edges (whiles the touching edges are like immoveable centers that the others turn upon) till at length they shut out all the aire, and close together, like the two legs of a compasse.

But neither is it possible that this way they should touch, for after their first touch by one line (which neither is in effect a touching, as we have shewed) no other parts of them can touch, though still they approach nearer and nearer, untill their whole surfaces do entirely touch at once: and therefore, the aire must in this case leap out in an instant a greater space, then if the surfaces came perpendicularly to one another; for here it must flie from one extremity to the other: whereas, in the former case, it was to go but from the middle to each side.

And thus it is evident, that no two bodies can arrive to touch one another, unlesse one of them at the least have a superficies plyable to the superficies of the other; that is, unlesse one of them be soft, which is, to be liquide in some degree. Seeing then, that by touching, bodies do become one; and that liquidity is the cause and means wherby bodies arrive to touch; we may boldly conclude that two liquide bodies do most easily and readily become one; and next to two such, a liquide and a hard body, are soonest united: but two hard ones most difficultly.

To proceed then with our reflections upon the composition of bodies, and upon what resulteth out of the joyning and mixture of their first differences Rarity and Density; we see, how if a liquide substance happeneth to touch a dry body it sticketh easily there.

8.

How mixed bodies are framed in general.

thereunto. Then consider, that there may be so small a quantity of such a liquide body, as it may be almost impossible for any naturall agent to divide it further into any lesse parts; and suppose that such a liquide part is between two dry parts of a dense body, and sticking to them both, becometh in the nature of a gliew to hold them together: will it not follow out of what we have said, that these two dense parts will be as hard to be severed from one another, as the small liquide part by which they stick together is to be divided? So that, when the viscuous ligaments which in a body do hold together the dense parts, are so small and subtile, as no force we can apply unto them can divide them, the adhesion of the parts must needs grow then inseparable. And therefore, we use to moisten dry bodies, to make them the more easily be divided; whereas those that are overmoist are of themselves ready to fall in peices. And thus you see how in generall, bodies are framed.

Out of which discourse, we may ballance the degrees of solidity in bodies, for all bodies being composed of humide and dry parts, we may conceive either kind of those parts, to be bigger or lesser, or to be more rare or more dense. Now if the dry parts of any body be extreme little and dense; and the moist parts that joyn the dry ones together, be very great and rare; then that body will be very easie to be dissolved. But if the moist parts which gliew together such extreme little and dense dry parts, be either lesser in bulk or not so rare; then the body composed of them will be in a stronger degree of consistence. And if the moist parts which serve for this effect, be in an excessse of littlenesse and withall dense; then, the body they compose will be in the highest degree of consistence that nature can frame.

On the other side; if you gliew together great dry parts, which are moderately dense and great, by the admixtion of humide parts that are of the least size in bulk, and dense withall; then the consistence will decrease from the height of it by how much the parts are greater, and the density lesse. But if unto dry parts of the greatest size, and in the greatest remisseness of density, you adde humide parts that are both very great and very rare, then the composed body will prove the most easily dissolvable of all that nature affordeth.

9.
The cause of the severall degrees of solidity in mixed bodies.

After this, casting our eyes a little further towards the composition

10.
The rule where-

urto are redu-
ced all the fe-
verall combi-
nations of Ele-
ments; in com-
pounding of
mixed bodies.

position of particular bodies; we shall find still greater mixtures, the further we go; for as the first and simplest compounded bodies, are made of the foure Elements; so, others are made of these; and again a third sort of them: and so onwards, according as by motion, the parts of every one are broken in sunder, and mingled with others. Those of the first order, must be of various tempers according to the proportions of the Elements, whereof they are immediately made. As for example, such a proportion of fire to the other three Elements, will make one kind of simple body, and another proportion will make another kind: and so throughout, by various combinations and proportions among all the Elements.

In the effecting of which work, it will not be amisse to look a little upon nature; and observe how she mingleth and tempereth different bodies one with another, whereby she begetteth that great variety of creatures which we see in the world. But because the degrees of composition are infinite, according to the encrease of number, we will contain our selves within the common notions of excessse in the foure primary components; for if we should descend once to specifie any determinate proportions, we should endanger losing our selves in a wood of particular natures, which belong not to us at present to examine. Then taking the foure Elements as materials to work upon: let us first consider how they may be varied, that differing compositions may result out of their mixtures. I conceive that all the wayes of varying the elements in this regard, may be reduced to the severall sizes of bignesse, of the parts of each Element, that enter into the composition of any body, and to the number of those parts: for certainly no other can be imagined, unlesse it were variety of figure.

But that cannot be admitted to belong in any constant manner to those least particles whereof bodies are framed; as though determinate figures were in every degree of quantity due to the natures of elements, and therefore, the elements would conserve themselves in those figures, as well in their least atomes, as in massie bulk: for seeing how these little parts are shuffled together without any order; and that all liquids easily joyn, and take the figures which the dense ones give them; and that they again, justling one another, do crush themselves into new shapes,

which

which their mixture with the liquid ones, maketh them yield the more easily unto: it is impossible that the elements should have any other naturall figure in these their least parts, then such as chance giveth them. But that one part must be bigger then another is evident; for the nature of rarity and density giveth it: the first of them causing divisibility into little parts, and the latter hindering it.

Having then settled in what manner the elements may be varied in the composition of bodies; let us now begin our mixture. In which our ground to work upon must be earth and water; for onely these two are the basis of permanent bodies, that suffer our senses to take hold of them, and that submit themselves to triall: whereas if we should make the predominant element to be aire or fire, and bring in the other two solid ones under their jurisdiction to make up the mixture, the compound resulting out of them would be either in continuall consumption (as ordinary fire is) or else imperceptible to our eyes or touch, and therefore not a fit subject for us to discourse of, since the other two afford us enough to speculate upon. Peradventure our sinell might take some cognisance of a body so composed, or the effect of it taken in by respiration, might in time shew it self upon our health: but it concerneth not us now to look so far; our designe requireth more maniable substances.

Of which let water be the first; and with it we will mingle the other three elements, in excessse over one another by turns; but still all of them overswayed by a predominant quantity of water: and then let us see what kind of bodies will result out of such proportions. First, if earth prevail above fire and aire, and arrive next in proportion to the water, a body of such a composition must needs prove hardly liquid, and not easie to let its parts run asunder, by reason of the great proportion of so dense a body as earth that holdeth it together. Yet some inclination it will have to fluidnesse, by reason the water is predominant over all; which also will make it be easily divisible, and give very little resistance to any hard thing that shall be applyed to make way through it. In a word, this mixture maketh the constitution of mud, dirt, honey, butter, and such like things where the main parts are great ones. And such are the parts of earth and water in themselves.

II.

Earth and water are the basis of all permanent mixed bodies.

I 2.

What kind of bodies those are where water is the basis, and earth the predominant element over the other two.

13.

Of those bodies,
where water
being the basis,
aire is the pre-
dominant Ele-
ment.

Let the next proportion of excess in a watry compound, be of aire, which when it prevaileth, it incorporateth it self chiefly with earth; for the other Elements would not so well retain it. Now, because its parts are subtiler (by reason of the rarity it hath) and sticking, (because of its humidity) it driveth the earth and water likewise into lesser parts. The result of such a mixture is, that the parts of a body compounded by it are close, catching, flowing slowly, glibbe, and generally it will burn, and be easily converted into flame.

Of this kind, are those which we call oylly or unctuous bodies whose great parts are easily separated, (that is, they are easily divisible in bulk,) but the small ones very hardly. Next the limalnesse, and well-working of the parts, by means of the aires penetrating every dense one, & sticking close to every one of them, and consequently, joyning them without any unevennesse; causeth that there can be no ruggednesse in it; and therefore, it is glibbe: in like manner as we see plaster or starch become smooth when they are well wrought. Then, the humidity of it causeth it to be catching, and the shortnesse of every part, maketh that where it sticketh, it is not easily parted thence. Now, the rarity of aire next unto fire, admitteth it to be (of all the other Elements) most easily brought to the height of fire, by the operation of fire upon it. And therefore, oyles are the proper food of that Element. And accordingly we see, that if a drop of oyl be spilled upon a sheet of paper, and the paper be set on fire at a corner; as the fire cometh near the oyl, the oyl will disperse and spread it self upon the paper to a broader compasse then it had; which is, because the heat rarifyeth it; and so, in oyl it self, the fire rarifying the aire, maketh it penetrate the earthy parts adjoynd unto it, more then it did; and so subtilizeth them, till they be reduced to such a height as they are within the power of fire to communicate his own nature unto them: and thus, he turneth them into fire, and carrieth them up in his flame.

14.

What kind of
bodies result,
where water is
the basis, and
fire the pre-
dominant Element.

But if fire be predominant over earth and aire in a watry compound; it maketh the body so proportioned, to be subtiler, rarer, penetrative, hot in operation, light in weight, and subject to burn. Of this kind are all sorts of wines, and distilled spirits, commonly called strong waters or Aquavites; in Latine *Aquæ ardentis*.

ardentes. These will lose their virtues merely by remaining uncovered in the aire; for fire doth not incorporate strongly with water; but, if it find means, raiseth it self into the aire; as we see in the smoke of boyling water which is nothing else but little bodies of fire, that entering into the water, do rarifie some parts of it; but have no inclination to stay there, and therefore as fast as they can get out, they fly away; but the humide parts of the water, which they have rarified (being of a sticking nature) do joyn themselves unto them, and ascend in the aire as high as the fiery atomes have strength to carry them: which when it faileth them that smoke falleth down in a dew, and so becometh water again as it was. All which one may easily discern in a glasse-veffell of water set over the fire; in which one may observe the fire come in at the bottome, and presently swim up to the top like a little bubble, and immediately rise from thence in smoke; and that will at last convert it self into drops and settle upon some solid substance thereabouts.

Of these fiery spirits, some are so subtile, as of themselves they will vanish, and leave no residue of a body behind them; and Alchymists profess to make them so etheriall and volatile, that being poured out of a glasse from some reasonable height, they shall never reach the ground: but that before they come thither, they will be so rarified by that little motion, as they shall grow invisible like the aire, and dispersing themselves all about in it, they will fill the chamber with the smell of that body which can no longer be seen.

The last excess in watery bodies, must be of water it self, which is, when so little a proportion of any of the other is mingled with it, as is hardly perceptible: out of this composition do arise all those severall sorts of juices or liquors, which we commonly call waters: which by their mixture with the other three Elements, have peculiar properties beyond simple Elementall water. The generall qualitie whereof, we shall not need any further to expresse, because by what we have already said of water in common, they are sufficiently known.

In our next survey, we will take earth for our ground to work upon, as hitherto we have done water: which if in any body, it be in the utmost excess of it beyond all the other three; then rocks and stones will grow out of it; whose drinnesse and hardnesse may assure

15.

Of those bodies, where water is in excess, it alone being both the basis, and the predominant Element.

16.

Of those bodies, where Earth alone is the basis, and also the predominant in excess over the other three Elements.

assure

assure us, that earth swayeth in their composition, with the least allay that may be. Nor doth their lightnesse (in respect of some other earthy compositions) impeach this resolution; for that proceedeth from the greatnesse and multiplicity of pores, where-with their drinesse causeth them to abound; and hindereth not, but that their reall soiid parts may be very heaue.

17.

Of those bodies where earth is the basis, & water the predominant element over the other two.

Now if we mingle a considerable proportion of water with earth, so as to exceed the fire and aire, but still inferiour to the earth; we shall produce metall; whose great weight with their ductility and malleability, plainly telleth us, that the smallest of waters grosse parts, are the glew that holdeth the earthy dense ones together: such weight belonging to earth, and that easie changing of parts, being most proper to water. Quick-silver (that is the generall matter whereof all the metalls are immediately composed) giveth us evidence hereof; for fire worketh upon it with the same effect as upon water. And the calcination of most of the metalls, proveth that fire can easly part and consume the glew by which they were closed and held together: which therefore must be rather of a watry then of an airy substance. Likewise the glibnesse of Mercury, and of melted metalls, without catching or sticking to other substances, giveth us to understand that this great temper of a moist element with earth is water, and not aire; and that the watry parts are compressed, and as it were shut up within the earthy ones: for aire catcheth and sticketh notably to all things it toucheth, and will not be imprisoned; the divisibility of it being exceeding great, though in never so short parts.

18.

Of those bodies where earth being the basis aire is the predominant.

Now if aire mingleth it self with earth, and be prodominant over water and fire; it maketh such an oily and fat soil, as husbandmen account their best mould; which receiving a betterment from the sunne and temperate heat, assureth us of the course of the aire: for wheresoever such heat is, aire cannot fail of accompanying it, or of being effected by it; and the richest of such earth (as pot-earth and marl) will with much fire grow more compacted, and stick closer together then it did; as we see in baking them into pots or fine bricks. Whereas if water were the glew between the dense parts, fire would consume it and crumble them asunder, as it doth in those bodies it calcinerth. And excessse of fire will bring them to vitrification; which still con-

confirmeth that aire aboundeth in them; for it is the nature of aire to stick so close where once it is kneaded in, as it cannot be separated without extreme difficulty. And to this purpose the viscuous holding together of the parts of glasse when it is melted, sheweth evidently that aire aboundeth in vitrified bodies.

The last mixture we are to meddle with, is of fire with earth, in an overruling proportion over aire and water. And this I conceive produceth those substances, which we may term coagulated juyces, and which the Latines do call *succi concreti*: whose first origine seemeth to have been liquours, that have been afterwards dried by the force either of heat or of cold. Of this nature are all kind of salts, niters, sulfurs, and divers sorts of bitumens. All which easily bewray the relicks and effects of fire left in them, some more some lesse according to their degrees.

And thus we have in generall deduced from their causes the complexions of those bodies, whereof the bulk of the world subjected to our use, consisteth; and which serve for the production and nourishment of living creatures, both animal and vegetable. Not so exactly (I confesse) nor so particularly, as the matter in it self, or as a Treatise confined to that subject, would require: yet sufficiently for our intent. In the performance whereof, if more accurate searchers of nature shall find that we have peradventure been mistaken in the minute delivering of some particular bodies complexion; their very correction (I dare boldly say) will justifie our principall scope: which is, to shew that all the great variety we see among bodies ariseth out of the commixtion of the first qualities and of the Elements: for they will not be able to correct us upon any other grounds then those we have laid.

As may easily be perceived, if we cast a summary view upon the qualities of composed bodies. All which we shall find to spring out of rarity and density, and to favour of their origine: for the most manifest qualities of bodies may be reduced to certain pairs opposite to one another. As namely some are liquid and flowing, others are consistent; some are soft, others hard, some are fatty, viscuous, and smooth, others lean, gritty, and rough; some grosse, others subtile; some tough, others brittle: and the like. Of which, the liquid, the soft, the fat, and the viscuous, are so manifestly derived from rarity, that we need not

19.

Of those bodies where earth being the basis fire is the predominant.

20.

All the second qualities of mixed bodies, arise from severall combinations of the first qualities: and are at last resolved into severall degrees of rarity and density.

take

take any further pains to trace out their origine: and the like is of their contraries from the contrary cause; to wit, of those bodies that are consistent, hard, lean, and gritty, all which do evidently spring from density. As for smoothness, we have already shewed how that proceedeth from an airy or oily nature; and by consequence, from a certain degree of rarity. And therefore roughness (the contrary of it) must proceed from a proportionable degree of density. Toughness is also a kind of ductility, which we have reduced to watriness, that is, to another degree of rarity; and consequently brittleness must arise from the contrary degree of density. Lastly, grossness and subtilness do consist in a difficulty or facility to be divided into small parts, which appeareth to be nothing else but a certain determination of rarity and density. And thus we see how the severall complexions of bodies are reduced to the foure elements that compound them: and the qualities of those bodies, to the two primary differences of quantative things by which the elements are diversified.

21.

That in the planets & stars there is a like variety of mixed bodies caused by light as here upon earth.

And out of this discourse it will be evident, that these complexions and qualities, though in diverse degrees, must of necessity be found wheresoever there is any variation in bodies: for seeing there can be no variation in bodies, but by rarity and density; and that the pure degrees of rarity and density do make heat, cold, moisture, and driness, and (in a word) the foure elements; it is evident, that wheresoever there is variety of bodies, there must be the foure Elements; though peradventure far unlike these mixed bodies which we call elements. And again, because these elements cannot consist without motion; and because by motion they do of necessity produce mixed bodies, and forge out those qualities which we come from explicating; it must by like necessity follow, that wheresoever there is any variety of active and passive bodies; there mixed bodies likewise must reside of the same kinds, and be indued with qualities of the like natures, as those we have treated of; though peradventure such as are in other places of the world remote from us, may be in a degree far different from ours.

Since then it cannot be denied, but that there must be notable variety of active and passive bodies wheresoever there is light: neither can it be denied but that in all those great bodies from which

which light is reflected unto us, there must be a like variety of complexions and of qualities, and of bodies tempered by them, as we find here in the orb we live in. Which systeme, how different it is from that which Aristotle and the most of the school have delivered us, as well in the evidencies of the proofs for its being so; as in the position and modell of it; I leave unto the prudent readers to consider and judge.

Out of what hath been already said, it is not hard to discover in what manner the composition of bodies is made. In effecting of which, the main hinge whereon that motion dependeth is fire or heat: as it likewise is in all other motions whatsoever. Now because the composition of a mixed body, proceedeth from the action of one simple body or element upon the others; it will not be amisse to declare by some example how this work passeth: for that purpose let us examine how fire or heat worketh upon his fellows.

By what we have formerly delivered, it is clear that fire streaming out from its center, and diffusing it self abroad, so as to fill the circumference of a larger circle, it must needs follow, that the beams of it are most condensed and compacted together near the center; and the further they stream from the center, the more thin and rarified they must grow: yet this is with such moderation, as we cannot any where discern that one beam doth not touch another; and therefore the distances must be very small. Now let us suppose that fire happeneth to be in a viscuous & tenacious body; and then consider what will happen in this case: of one side, the fire spreadeth it self abroad; on the other side, the parts of the tenacious body being moist (as we have formerly determined) their edges on all hands will stick fast to the dry beams of the fire that passe between them. Then they stretching wider and wider from one another, must needs draw with them the parts of that tenacious body which stick unto them; and stretch them into a greater wideness or largenes then they enjoyed before, from whence it follows, that (seeing there is no other body near thereabouts but they two) either there must be a vacuity left, or else the tenacious body must hold and fill a greater space then it did before, and consequently be more rare.

Contrariwise, if any of the other elements be stronger then fire, the denser elements break off from their continued stream the

22.

In what manner the elements do work upon one another, in the composition of mixed bodies: and in particular fire which is the most active

little parts of fire which were gotten into their greater parts: and sticking on all sides about them, they do so enclose them that they have no more semblance of fire: and if afterwards by any accident there cometh a great compression, they force them to lose their naturall rarity, and to become some other Element. Thus it fareth with fire, both in acting and in suffering. And the same course, we have in both these regards expressed of it, passeth likewise in the rest of the Elements to the proportion of their contrarities.

Hence it followeth that when fire meeteth with humidity in any body, it divideth and subtiliseth it, and disperseth it gently, and in a kind of equall manner through the whole body it is in. (if the operation of it be a naturall and a gentle one) and so driveth it into other parts, which at the same time it prepareth to receive it by subtilising likewise those parts. And thus moderate fire, maketh humour in very small parts to incorporate it self in an even or uniform manner with the dry parts it meeteth withall: which being done whether the heat doth afterwards continue, or that cold succeedeth in lieu of it, the effect must of necessity be, that the body thus composed, be bound up and fastened, more or lesse according to the proportion of the matter it is made of, and of the Agents that work upon it, and of the time they employ about it. This is every day seen, in the ripening of fruits and in other frequent works, as well of art as of nature, and is so obvious, and sensible to any reasonable observation that it is needles to enlarge my self much upon this subject

23.

A particular
declaration
touching the
generation of
metalls.

Onely, it will not be amisse, for examples sake, to consider the progresse of it in the composing or augmenting of metall, or of earths of divers sorts: first heat (as we have said) draweth humour out of all the bodies it worketh upon: then if the extracted humour be in quantity and the steams of it do happen to come together in some hollow place, fit to assemble them into greater parts; they are condensed and they fall down in a liquid and running body. These steams being thus corporified, the body resulting out of them, maketh it self in the earth a channell to runne in: and if there be any loose parts in the channell, they mingle themselves with the running liquour: and though there be none such, yet in time the liquour it self looseth the channell all about, and imbibeth into its own substance the

the parts it raiseth. And thus, all of them compacted together, do roll along till they tumble into some low place, out of which they cannot so easily get to wander further. When they are thus settled, they do the more easily receive into them, and retain such heat as is every where to be met withall, because it is diffused more or lesse through the earth. This heat if it be sufficient digesteth it into a solide body: the temper of cold likewise concurring in its measure to this effect. And according to the variety of the substances whereof the first liquour was made, and which it afterwards drew along with it; the body that resulteth out of them is diversified. In confirmation of all which they that deal in mines tell us they use to find metall oftentimes mingled with stones; as also coagulated juyces with both; and earths of divers natures with all three; and they with it, and one with another among themselves. And that sometimes they find the mines not yet consolidated and digested throughly into metall; when by their experience knowing after how many yeares they will be ripe, they shut them up again till then.

Now if the hollow place wherein the body stayed (which at the first was liquid and rolling) be not at once filled by it, but it taketh up onely part of it; and the same liquour continueth afterwards to flow thither: then this body is augmented, and groweth bigger and bigger. And although the liquours should come at severall times, yet they become not therefore two severall bodies, but both liquours do grow into one body: for the wet parts of the adventitious liquour do mollifie the sides of the body already baked; and both of them being of a like temper and cogitation, they easily stick and grow together.

Out of this discourse it followeth evidently, that in all sorts of compounded bodies whatsoever, there must of necessity be actually comprised sundry parts of divers natures: for otherwise, they would be but so many pure degrees of rarity and density; that is, they would be but so many pure elements, and each of them have but one determinate virtue or operation.

C H A P. XV.

Of the dissolution of mixed bodies.

THUS much for composition of bodies. Their dissolution is made three wayes; either by fire, or by water, or by some

I.
Why some bodies are brittle,

& others tough or apt to withstand outward violence, the first instrument to dissolve mixed bodies.

outward violence. We will begin with examining how this last is done: to which end we may consider, that the unity of any body consisting in the connexion of its parts; it is evident that the force of motion if it be exercised upon them, must of necessity separate them, as we see in breaking, cutting, filing, drawing a-sunder, and the like.

All these motions, because they are done by grosse bodies, do require great parts to work upon, and are easily discerned how they work: so that it is not difficult to find the reason why some hard bodies break easily, and others with much ado. The first of which are called brittle, the others tough. For if you mark it, all breaking requireth that bending should precede; which on the one side compresseth the parts of the bended body, & condenseth them into a lesser room then they possessed before; and on the other side stretcheth them out, and maketh them take up more place. This requireth some fluid or moveable substance to be within the body, else it could not be done; for without such help the parts could not remove. Therefore such hard bodies as have most fluid parts in them, are most flexible, that is; are toughest. And those which have fewest, though they become thereby hardest to have impression made upon them, yet if the force be able to do it, they rather yield to break then to bend, & thence are called brittle.

Out of this we may infer, that some bodies may be so suddenly bent as that thereby they break a-sunder; whereas if they were leisurely and gently dealt withall, they would take what ply one desireth. And likewise that there is no body (be it never so brittle and hard) but that it will bend a little (and indeed more then one would expect) if it be wrought upon with time & dexterity; for there is none but containeth in it some liquid parts more or lesse; even glasse and brick. Upon which occasion I remember, how once in a great storme of wind, I saw the high slender brick chimneys of the Kings house at S. James (one winter when the Court lay there) bend from the wind like boughs, and shake exceedingly and totter. And at other times I have seen some very high and pointy spire steeple do the like. And I have been assured the like of the whole pile of a high castle, standing in a gullet in the course of the wind (namely the castle of Wardour) by those who have often seen it shake notably in a fierce wind.

The

The reason of all which may be deduced out of what we have said above: for seeing that the bending of a body maketh the spirits or humours that are within it to fall forth; it is clear that if the violence which forceth it be not so sudden, nor the motion it receiveth be not so quick, but that the moisture may oose gently out; the body will bend still more and more, as their absence giveth it leave. But if the motion that is wrought in it be too quick, then the spirits not having time allowed them to go leisurely and gently out, do force their prison, and break out with a violence, and so the body is snapped into two.

Here peradventure some remembring what we have said in another place; namely, that it is the shortness and littleness of the humid parts in a body which maketh it stick together; and that this shortness may be in so high a degree, as nothing can come between the parts they glew together to divide them; may ask, how a very dense body of such a strain, can be broken or divided? But the difficulty is not great, for seeing that the humid parts in whatsoever degree of shortness they be, must necessarily have still some latitude; it cannot be doubted but there may be some force assigned greater then their resistance can be. All the question is, how to apply it to work its effect upon so close a compacted body, in which peradventure the continuity of the humid parts that bind the others together, may be so small, as no other body whatsoever (no, not fire) can go between them, in such sort as to separate part from part. At the worst, it cannot be doubted but that the force may be so applyed at the outside of that body, as to make the parts of it presse and fight one against another, and at the length by multiplication of the force, constrain it to yield and suffer division. And this I conceive to be the condition of gold and of some precious stones: in which the elements are united by such little parts, as nothing but a civill warre within themselves (stirred up by some subtille outward enemy, whereby they are made to tear their own bowels) could bring to passe their destruction.

But this way of dissolving such bodies, more properly belongs to the next way of working upon them by fire: yet the same is done when some exterior violence pressing upon those parts it toucheth, makes them cut a way betwixt their next neighbours; & so continuing the force divide the whole body. As when the chisell

2.

How outward violence doth work upon the most compacted bodies.

or even the hammer with beating, breaketh gold asunder: for it is neither the chisell, nor the hammer that doth that effect immediately; but they make those parts they touch, cut the others that they are forced upon. In such sort as I remember happened to a gentleman that stood by me (in a sea-fight I was in) with a coat of mail upon his body, when a bullet coming against a bony part in him, made a great wound, and shattered all the bones near where it struck: and yet the coat of mail was whole: it seemeth the little links of the mail yielding to the bullets force made their way into the flesh and to the bone.

3.
The severall effects of fire, the second and chiefest instrument to dissolve all compounded bodies.

But now it is time to come to the other two instruments of separation of bodies, fire and water; and to examine how they dissolve compounds. Of these two; the way of working of fire, is the easiest and most apparant to be discerned. We may readily observe how it proceedeth, if we but set a piece of wood on fire; in which it maketh little holes as if with bodkins it pierced it. So that the manner of its operation in common being plain, we need but reflect a little upon the severall particular degrees of it. Some bodies it seemeth not to touch; as clothes made of Asbestus; which are onely purified by it. Others, it melteth, but consumeth not; as gold. Others it turneth into powder suddenly dissolving their body; as lead, and such metall as are calcined by pure fire. Others again, it separateth into a greater number of differing parts; as into spirits, waters, oyls, salts, earth and glasse: of which rank are all vegetables. And lastly, others it converteth into pure fire, as strong waters, or Aquavites (called aquæ ardentes) and some pure oyls: for the smoke that is made by their setting on fire, and peradventure their salt is so little as is scarce discernable. These are in summe the divisions which fire maketh upon bodies, according to the nature of them, and to the due application of it unto them: for by the help & mediation of other things, it may peradventure work other effects

4.
The reason why some bodies are not dissolved by fire.

Now to examine a little in particular, how the same fire, in differing subjects, produceth such different effects: *Limus ut hic durefcit, & hac ut cera liquefcit, Uno eodémque igni;*

We will consider the nature of every one of the subjects apart by it self. First, for the Asbestus: it is clear, that it is of a very dry substance; so that to look upon it, when it is broken into very little pieces, they seem to be little bundles of short hairs, the

the liquidity within, being so little as it affordeth the parts neither length nor breadth: and therefore, fire meeteth with little there that it can dilate. But what it cannot dilate, it cannot separate; nor carry away any thing of it, but what is accidentally adherent unto the outsides of it. And so it seemeth onely to passe through the pores, and to cleanse the little thrids of it: but bringeth no detriment at all to the substance of it. In this I speak onely of an ordinary fire: for I doubt not but such a one it might be, as would perfectly calcine it.

The next body we spoke of is gold. This aboundeth so much in liquidity, that it sticketh to the fire, if duely applyed: but its humidity is so well united to its earthy parts, and is so perfectly incorporated with them; as it cannot carry away one, without likewise carrying away both: but both, are too heavy a weight for the little agile parts of fire to remove. Thus, it is able to make gold swell; as we see in melting it: in which, the gold receiveth the fire into its bowels and retaineth it a long time with it: but at its departure, it permitteth the fire to carry nothing away upon its wings: as is apparant, by the golds no whit decay of weight, after never so long fusion. And therefore, to have fire make any separation in gold, requireth the assistance of some other moist body, that on the one side may stick closely to the gold, when the fire driveth it into it, and on the other side may be capable of dilatation, by the action of the fire upon it. As in some sort we see in strong waters made of salts, which are a proper subject for the fire to dilate, who, by the assistance of fire, mingling themselves closely with little parts of the gold, do pull them away from their whole substance, and do force them to bear them company in their journey upwards, in which, multitudes of little parts of fire, do concurre to presse them on and hasten them: and so, the weight of gold being at length overcome by these two powerfull Agents (whereof one supplyeth, what the other wanteth) the whole substance of the metall, is in little atoms diffused through the whole body of the water. But this is not truly a dissolution or a separation of the substantiall parts of gold, one from another: it is onely a corrosion, which bringeth it into a subtile powder, (when the water & salts are separated from it) much like what filing (though far smaller) or grinding of leaf gold upon a porphyre stone, may reduce it into: for neither the

5.
The reason why fire melteth gold but cannot consume it.

parts of the water, nor of the fire that make themselves away into the body of the gold, are small and subtil enough to get between the parts that compose the essence of it: and therefore all they can attain unto, is to divide it onely in his quantity or bulk, not in the composition of its nature.

Yet I intend not to deny but that this is possible to be arrived unto, either by pure fire duly applyed, or by some other assistance; as peradventure by some kind of Mercury; which being of a nearer cognation unto metall than any other liquor is, may happily have a more powerfull ingression into gold, than any other body whatsoever; and being withall very subject to rarefaction, it may (after it is entered) so perfectly penetrate the gold, as it may separate every least part of it, and so reduce it into an absolute calx. But in this place I explicate no more then what ordinarily passeth, leaving the mysteries of this art to those who profess it.

6.
Why lead is easily consumed and calcined by fire.

To go on then with what we have in hand: lead hath abundance of water overmingled with its earth, as appeareth by its easie yielding to be bent any way, and by its quiet standing bent in the same position that the force which bowed it leaveth it in, And therefore the liquid parts of lead, are easily separated from its dry and earthy ones: and when it is melted, the very shaking of it, causeth the grosse parts to descend, and many liquid ones to flie away with the fire; so that suddenly it is thus converted into powder. But this powder is grosse in respect of other metall; unless this operation be often reiterated, or the fire more powerfully applyed, then what is just enough to bring the body of the lead into powder.

7.
Why and how some bodies are divided by fire into spirits, waters, oyles, salts, and earth. And what those parts are.

The next consideration of bodies that fire worketh upon, is of such as it divideth into spirits, salts, oyles, waters, or phlegms, and earth. Now these are not pure and simple parts of the dissolved body, but new compounded bodies made of the first by the operation of heat. As smoke is not pure water, but water and fire together: and therefore becometh not water but by cooling, that is, by the fire flying away from it. So likewise those spirits, salts, oyles, and the rest; are but degrees of things which fire maketh of diverse parts of the dissolved body, by separating them one from another, and incorporating it self with them. And so they are all of them compounded of the soure Elements, and are further resolvable into them. Yet

Yet I intend not to say that there are not originally in the body before its dissolution, some loose parts which have the properties of these bodies that are made by the fire in the dissolving of it: for seeing that nature worketh by the like instruments as art useth, she must needs in her excesses and defects produce like bodies to what art doth in dissolution; which operation of art is but a kind of excess in the progresse of nature: but my meaning is, that in such dissolution there are more of these parts made by the working of fire, then were in the body before.

Now because this is the naturall and most ordinary dissolution of things; let us see in particular how it is done: suppose then that fire were in a convenient manner applyed to a body that hath all sorts of parts in it; and our own discourse will tell us, that the first effect it worketh will be, that as the subtile parts of fire do divide and passe through that body, they will adhere to the most subtile parts in it; which being most agile and least bound and incorporated to the bowels of the body, and lying (as it were) loosely scattered in it, the fire will carry them away with it. These will be the first that are separated from the main body; which being retained in a fit receiver, will by the coldnesse of the circumdant aire grow outwardly cool themselves, and become first a dew upon the sides of the glasse, and then still as they grow cooler, condense more and more; till at the length they fall down congealed into a palpable liquour; which is composed (as you see) of the hottest parts of the body, mingled with the fire that carried them out: and therefore this liquour is very inflammable, and easily turned into actuall fire; as you see all spirits and *Aqua ardentis* of vegetables are.

The hot and loose parts being extracted, and the fire continuing and encreasing, those that will follow next are such as though they be not of themselves loose, yet are easiest to be made so; and are therefore most separable. These must be humide, and those little dry parts which are incorporated with the overflowing humide ones in them (for no parts that we can arrive unto are of one pure simple nature; but all are mixed and composed of the foure elements in some proportion) must be held together with such grosse glew as the fire may easily penetrate and separate them. And then the humide parts divided into little atomes do stick to the lesser ones of the fire: which by their multitude

of number and velocity of motion, supplying what they want of them in bulk; do carry them away with them. And thus these phlegmatick parts flie up with the fire and are afterwards congealed into an insipide water: which if it have any favour, is because the first ardent spirits are not totally separated from it, but some few of them remain in it, and give some little life to the whole body of that otherwise flat liquor.

Now those parts which the fire separateth next from the remaining body, after the fiery and watry ones are carried away, must be such as it can work upon: and therefore must abound in humidity. But since they stir not till the watry ones are gone, it is evident that they are composed of many dry parts strongly incorporated, and very subtilly mixed with the moist ones; & that both of them are exceeding small, and are so closely and finely knit together, that the fire hath much ado to get between them, and cut the thrids that tie them together: and therefore they require a very great force of fire to carry them up. Now the composition of these sheweth them to be aeriall: and (together with the fire that is mingled with them) they congeal into that consistence which we call oyl.

Lastly, it cannot be otherwise but that the fire, in all this while of continuall application to the body it thus anatomiseth; hath hardened, and as it were rosted some parts into such greatnesse and driness as they will not flie, nor can be carried up with any moderate heat. But great quantity of fire being mingled with the subtiler parts of his baked earth maketh them very pungent and acrimonious in tast: so that they are of the nature of ordinary salt, and are so called; and by the help of water may easily be separated from the more grosse parts which then remain a dead and uselesse earth.

By this discourse it is apparent, that fire hath been the instrument which hath wrought all these parts of an entire body into the forms they are in; for whiles it carried away the fiery parts, it swelled the watry ones; and whiles it lifted up them it digested the aeriall parts, and whiles it drove up the oyls, it baked the earth and salt. Again, all these retaining for the most part, the proper nature of the substance from whence they are extracted; it is evident that the substance is not dissolved; (for so the nature of the whole would be dissolved and quite destroyed & extinguished

in every part) but that onely some parts containing the whole substance, or rather the nature of the whole substance in them, are separated from other parts that have likewise the same nature in them.

The third instrument for the separation and dissolution of bodies is water, whose proper matter to work upon is salt. And it serveth to supply what the fire could not perform, which is the separation of the salt from the earth in calcined bodies. All the other parts fire was able to sever, but in these he hath so baked the little humidity he hath left in them with their much earth; as he cannot divide them any further. And so though he incorporateth himself with them, yet he can carry nothing away with him. If then pure water be put upon that chalk, the subtillest dry parts of it do easily joyn to the supervenient moysture, & sticking close to it do draw it down to them: but because they are the lighter, it happeneth to them as when a man in a boat pulleth the land to him; that cometh not to him, but he removeth himself and his boat to it: so these ascend in the water as they dissolve. And the water more and more penetrating them, and by addition of its parts making the humidity which gleweth their earthy parts together greater and greater, doth make a wider and wider separation between those little earthy parts; and so imbueth the whole body of the water with them, into which they are dispersed in little atomes. Those that are of biggest bulk remain lowest in the water. And in the same measure as their quantities dissolve into lesse and lesse, they ascend higher and higher in the water; till at the length the water is fully replenished with them, and they are diffused through the whole body of it: whiles the more grosse and heaveie earthy parts (having nothing in them to make a present combination between them and the water) do fall down to the bottom, and settle under the water in dust.

In which because earth alone doth predominate in a very great excessse, we can expect no other virtue to be in it, but that which is proper to mere earth; to wit, driness and weight. Which ordinary Alchymists look not after: and therefore call it *terra damnata*: but others find a fixing quality in it, by which they perform very admirable operations. Now if you poure the impregnated water from the *terra damnata*, and then eva-

8.

How water the third instrument to dissolve bodies, dissolveth calx into salt, and so into *Terra damnata*.

porate it, you will find a pure white substance remaining: Which by its bulk sheweth it self to be very earthy, and by its pricking, and corrosive taste, will inform you much fire is in it, and by its easie dissolution in a moist place, that water had a great share in the production of it. And thus the salts of bodies are made and extracted.

9.
How water mingled with salt, becometh a most powerful Agent to dissolve other bodies.

Now as water doth dissolve salt, so by the incorporation and virtue of that corrosive substance it doth more then salt it self can do: for having gotten acrimony, and more weight by the mixture and dissolution of salt in it, it maketh it self a way into solide bodies, even into metalls, as we see in brasse and iron; which are easily rusted by salt dissolving upon them. And according as the salts are stronger, so this corrosive virtue encreaseth in them, even so much, as neither silver nor gold are free from their eating quality. But they, as well as the rest, are divided into most small parts, and are made to swimme in water, in such sort as we have explicated above, and whereof every ordinary Alchymist teacheth the practise.

But this is not all; salts do help as well to melt hard bodies and metalls, as to corrode them: for some fusible salts flowing upon them by the heat of the fire, and others dissolved by the steam of the metall that incorporateth with them; as soon as they are in fluxe, they mingle with the naturall juice of the metall, and penetrate them deeper, then without them the fire could do, and swell them and make them fit to run.

10.
How putrefaction is caused.

These are the principall wayes of the two last instruments in dissolving of bodies; taking each of them by it self. But there remaineth one more of very great importance, as well in the works of nature as of art; in which, both the former are joyued and do concur: and that is putrefaction. Whose way of working is by gentle heat and moisture to wet and pierce the body it worketh upon; whereby, it is made to swell: and the hot parts of it, being loosened, they are at length drunk up and drowned in the moist ones (from whence, by fire they are easily separated as we have already declared;) and those moist parts, afterwards leaving it, the substance remaineth dry, and falleth in peeces, for want of the glew that held it together.

CHAP. XVI.

An explication of certain Maximes touching the operations and qualities of bodies: and whether the Elements be found pure in any part of the world.

Of what we have determined, concerning the naturall actions of bodies, in their making and destroying one another; it is easie to understand the right meaning of some terms, and the true reason of some maximes much used in the schools. As first; when Philosophers attribute unto all sorts of corporeall Agents, a *Sphere of Activitie*. The sense of that manner of expression, in fire appeareth plainly, by what we have already declared of the nature and manner of operation of that Element.

I.
What is the
Sphere of acti-
vity in corpore-
all Agents.

And in like manner, if we consider how the force of cold consisteth in a compression of the body that is made cold, we may perceiue that if in the cooled body there be any subtile parts which can break forth from the rest, such compression will make them do so. Especially, if the compression be of little parts of the compressed body within themselves, as well as of the outward bulk of the whole body round about: for at first the compression of such causeth in the body, where they are, little holes or pores in the places they are compressed and driven from; which pores they filled up when they were dilated at their own naturall liberry. But being thus forcibly shrunk up into lesse room, afterwards, they squeeze again out of their croud all such very loose and subtile parts (residing till then with them) as can find their way out from among them. And these subtile parts that thus are delivered from the colds compression, get first into the pores that we have shewed were made by this compression. But they cannot long stay there; for the atomes of aduenient cold that obfesse the compressed body, do likewise with all their force throng into those pores, and soon drive out the subtile guests they find there, because they are more in number, bigger in bulk, and more violent in their course then they. Who therefore must yield unto them the little channels, and capacities they formerly took up. Out of which they are thrust with such an impetuositie, that they spinne from them with a vehemence, as quick-

quicksilver doth through leather, when to purifie it, or to bring an Amalgame to a due consistence, it is strained through the sides of it.

Now these shows or streams of atomes issuing from the compressed body, are on all sides round about it at exceeding little distances; because the pores out of which they are driven, are so likewise. And consequently, there they remain round about besieging it, as though they would return to their originall homes, as soon as the usurping strangers that were too powerfull for them, will give them leave. And according to the multitude of them, and to the force with which they are driven out; the compasse they take up round about the compressed body, is greater or lesser. Which besieging atomes are not so soon carried away by any exterior and accidentall causes, but they are supplied by new emanations succeeding them out of the said compressed body.

Now this which we have declared by the example of cold, compressing a particular body, hapneth in all bodies wherefoever they be in the world: for this being the unavoydable effect of heat and of cold, wherefoever they reside; (which are the active qualities, by whose means not onely fire and water and the other two Elements; but all other mixed bodies composed of the Elements, have their activity) and they being in all bodies whatsoever (as we have proved above) it followeth evidently, that there is not a body in the world, but hath about it self an orbe of emanations of the same nature which that body is of: Within the compasse of which orbe, when any other body cometh that receiveth an immutation by the little atomes whereof that orbe is composed, the advenient body seemeth to be affected and as it were replenished with the qualities of the body from whence they issue. Which is then said to work upon the body that imbibeth the emanations that flow from it. And because this orbe (regularly speaking) is in the form of a sphere, the passive body is said to be within the sphere of the others activity.

Secondly, when Philosophers pronounce: that *No corpore- all nature can operari in distans*; that is, that no body can work upon another remote from it, without working first upon the body that lieth between them, which must continue and piece up the operation from the agent to the patient. The reason and truth of this maxime is in our Philosophy evident; for we having shewed

2.

The reason why no body can work in distance.

shewed

shewed that action among bodies is performed for the most part by the emission of little parts out of one body into another : as also, that such little parts cannot stream from the body that is their fountain, and settle upon a remote body, without passing through the interjacent bodies ; which must furnish them, as it were, with channels and pipes to convey them whither they are to go ; It followeth manifestly, that the active emissaries of the working body, can never reach their distant mark, unless they be successively ferried over the medium, that lieth between them; in which, they must needs leave impressions of their having been there, and so work upon it in their passage, and leave in it their qualities and complexions; as a payment for their wastage over.

But peradventure some may contend, that these invisible serjeants and workmen are too feeble and impotent to perform those visible great effects we daily see. As when fire at the length burneth a board that hath been a great while opposed to it, though it touch not the body of the fire ; or when a loadstone draweth unto it a great weight of iron that is distant from it.

Unto whom we shall reply, that if he will not grant these subtile emanations from the agent body, to be the immediate workers of these effects ; he must allot that efficacy unto the whole corpulency of all the Agent working in bulk (for besides the whole, and the parts there is no third thing to be considered in bodies; since they are constituted by quantity;) but the whole cannot work otherwise then by locall motion: which in this case it cannot do, because by the supposition, it is determined to keep its distance from the passive body, and not to move towards it. Therefore, this is impossible ; whereas the other can appear but difficult at the worst, and therefore must be admitted, when no better and more intelligible solution can be found.

But withall we must note that it is not our intention to say, but that it may in some circumstances happen that some particular action or effect may be wrought in a remote part or body, which shall not be the same in the intermediate body that lieth between the agent and the patient, & that conveyeth the agents working atoms to the others body. As for example when tinder or naphtha is by fire made to burn at a yard distance from it, when the interjacent aire is but warmed by that fire. Or when the sun, by means of a burning-glasse or of some other reflexion, setteth

some

3.
An objection
answered a-
gainst the man-
ner of explicat-
ing the former
axiome.

some bodies on fire, and yet onely enlighteneth the glasse and the aire that are in the way. The reason of which is manifest to be the divers dispositions of the different subjects in regard of the Agent: and therefore it is no wonder that divers effects should be produced according to those divers dispositions.

4.
Of reaction and
first in pure lo-
call motion, that
each Agent
must suffer in
acting and act
in suffering.

A third position among Philosophers is, that all bodies which work upon others, do like wise as the same time, wherein they work; suffer from those they work upon: and contrariwise that all bodies which suffer from others, do at the same time work back again upon them. For the better understanding whereof, let us consider that all action among bodies is either purely local motion, or else local motion with certain particularities which give it a particular name. As when we expresse the local motion of little atomes of fire, or of earth, or water upon and into other bodies by the words of heating or cooling; and so of the like. Now if the action be pure local motion, and consequently the effect produced by that action be merely change of place; we must call to mind how two dense bodies moving one against the other, do each of them bear before them some little quantity of a rarer body immediately joyned unto them: and consequently, these more rare bodies must be the first to feel the power of the dense bodies and to receive impressions from their motions; each of them, by the opposite rare body, which like an huiffier goeth before to make way for his following master that obligeth him to this service.

Now when these rare ushers have struggled a while like the first lightly-armed ranks of two armies in the interjacent field between their main battalies, that follow them close at the heels, they must at the length yield, when they are overborn by a greater weight then they can sustain; and then they recoile back, as it were to save themselves by getting in among the files of dense bodies that drove them on; which not opening to admit them, & yet they still flying violently from the mastering force that pursueth them; they presse so hard upon what at the first pressed them on, as notwithstanding their density and strength they force them to retire back: for unlesse they do so, they are not of the number of those that work upon one another.

And this retiring, is either on both sides, or but of one side. If both; then it is evident how each of them is an Agent, and each

of them a sufferer; each of them overcoming his opposite in such sort, as himself likewise receiveth blows and losse. But if onely one of the dense bodies be so shocked as to recoile back, then that onely suffereth in its body, and the other suffereth onely in its virtue; that is, in the aire or other rare body it sendeth before it; which it driveth with such a violence, that it mastereth and quelleth the opposition of the other body, before it can reach to shake the dense body, before which it runneth. Yet that rare body must be pressed and broken into, in some measure, by the incounter of the other (which though never so weak yet maketh some resistance) but much more when it cometh to grapple with the dense body it self: and so between them, it is wounded and infeebled, like those souldiers that first enter a breach in a town, from whence when they have driven the enemy, they pursue him to the cittadell, and force him from thence too; and so how maimed soever they prove, they make a free & easie way without resistance for the whole body of their army to follow them, and take quiet possession of that which did cost them so much to win.

And thus we see how it may happen that one of these moving bodies doth not suffer so much as to be stayed in its journey; much lesse, to be driven back. And yet the other body at the same time work in some measure upon it, by working upon what is next to it; which recoiling against it must needs make some impression upon it, since there can be no opposition but must have some effect. Now this impression or effect, though it be not perceptible by causing a contrary motion, yet it must needs infeeble the virtue of the conquering Agent, & deaden the celerity of its motion. And thus it is evident, that in all pure local motions of corporeall Agents, every one of them must in some proportion suffer in acting, and in suffering must act.

And what we have said of this kind of action, may easily be applied to the other where the effect of local motion is designed by a particular name, as it is in the examples we gave of heating and cooling. And in that, the proceeding will appear to be the very same as in this; for if fire doth heat water, the water reacteth again, either upon the fire and cooleth it, if it be immediate unto it; or else upon the interjacent aire, if it be at a distance from the fire. And so the aire is in some measure cooled, by the cold atomes that issue from the water, whose compasse or sphere

5.
The former doctrine applied to other local motions designed by particular names. And that Suisseths argument is of no force against this way of doctrine.

of activity being lesser then the fires, they cannot cool so farre off, as the others can heat: but where they do arrive, they give their proportion of cold, in the very midst of the others army of fiery atomes, notwithstanding their multitude and violence.

According to which doctrine, our countryman Suisseth his argument, that in the schools is held insoluble, hath not so much as any semblance of the least difficulty: for it is evident that such atomes of fire and of water as we determine heat and cold to be, may passe and croud by one another into the subjects they are sent unto by divers little streams without hindering one another (as we have declared of aire and light) and each of them be received in their own nature and temper by the same subject; though sense can judge onely according to which of them is predominant, and according to the proportion of its superiority.

Upon which occasion we cannot chuse but note, how the doctrine of qualities is not onely unable to give account of the ordinary and plain effects of nature; but also useth to end in cleer impossibilities and contradictions if it be driven far: as this argument of Suisseth sheweth, and many others of the like nature.

6.

Why some notions do admit of intension and remission; and others do not.

A fourth position among Philosophers is, that some notions do admit the denominations of Intension and Remission, but that others do not. The reason of which we shall clearly see, if we but consider how these termes of *intension and remission*, do but expresse *more or lesse*, of the thing that is said to be intended or remitted: for the nature of more and lesse doth imply a latitude and divisibility; and therefore cannot agree with the nature of such things as consist in an indivisible being. As for example to be a *whole* or to be an *equall*, cannot be sometimes more, sometimes lesse; for they consist in such a rigorous indivisible being, that if the least part imaginable be wanting it is no longer a *whole*, and if there be the least excessse between two things, they are no longer equall, but are in some other proportion then of equality in regard of one another.

And hence it is that Aristotle teacheth us that *substance* and the species of *Quantity*, do not admit of intension and remission; but that quality doth. For first in *substance*, we know that the signification of this word is, that w^{ch} maketh a thing be what it is, as is evident by our giving it for an answer to the question what a thing is. And therefore, if there were any divisibility
in

in substance, it would be in *what* the thing is; and consequently, every division following that divisibility, would make the thing another *what*; that is another thing. And so the substance that is pretended to be changed by intension or remission, would not be divided, as is supposed, but would cease to be, and another substance would succeed in the room of it. Whereby you see that every mutation in substance, maketh a new thing; and that more and lesse in quiddity cannot be pronounced of the same thing.

Likewise in quantity, it is clear that its Specieses do consist in an indivisible: for as in numbers, ten lions (for example) or ten Elephants are no more in regard of multitude then ten flees or ten motes in the sunne; and if you adde or take any thing from ten, it is no more ten, but some other number: so likewise in continued extension, a span, an ell, an ounce, or any other measure whatsoever, ceaseth to be a span and the rest, if you adde to it or diminish from it the least quantity Imaginable. And peradventure, the same is also of figures, as of a sphere, a cube, a circle, a square, &c. though they be in the ranke of qualities.

But if we consider such qualities as heat, cold, moysture, drinnesse, softnesse, hardnesse, weight, lightnesse, and the like; we shall find that they may be in any body sometimes more, sometimes lesse, (according as the excesse of any Element or mixture is greater in it, at one time then at another) and yet the body in which these qualities are intended or remitted, remain still with the same denomination. As when durt continueth still soft, though sometimes it be lesse soft, other whiles softer; and wax remaineth figurable, whether it be melted or congealed; and wood is still hot though it lose or gain some degree of heat.

But such intension in any subject whatsoever hath its determinate limits that it cannot passe; for when more of that quality that we say is intended (that is, more of the atomes of the active body) is brought into the body that suffereth the intension, then its complexion can brook; it resigneth its nature to their violence and becometh a new thing; such an one as they are pleased to make it. As when wood, with extremity of heating (that is, with bringing into it so many atomes of fire, that the fire is stronger in it then its own nature) is converted into fire, smoke, water, and ashes; and nothing remaineth of the nature of wood.

But before we end this chapter, we may remember how in the

part of our habitable world; all the four Elements, are found pure in small atomes; but not in any great bulk.

of the fourth we remitted a question concerning the existence of the Elements; (that is, whether in any places of the world there were any pure Elements, either in bulk or in little parts;) as being not ready to resolve it, till we had declared the manner of working of bodies one upon another. Here then will be a fit place to determine that, out of what we have discoursed concerning the actions, whereby bodies are made and corrupted: for considering the universal action of fire that runneth through all the bodies we have commerce withall, by reason of the suns influence into them and operation upon them with his light and beams which reacheth far and near; and looking upon the effects which we have shewed do follow thence: it is manifest, there cannot be any great quantity of any body whatsoever, in which fire is not intrinsically mixed. And on the other side, we see that where fire is once mixed it is very hard to separate it totally from thence. Again, we see it is impossible that pure fire should be conserved, without being adjoynd to some other body; both because of its violent nativity, still streaming forth with a great impetuosity; as also because it is so easily overcome by any obdient body when it is dilated. And therefore we may safely conclude, that no simple Element can consist in any great quantity in this course of nature which we live in and take a survey of. Neither doth it appear to what purpose nature should have placed any such storehouses of simples, seeing she can make all needfull complexions by the dissolutions of mixed bodies into other mixed bodies favouring of the nature of the Elements, without needing their purity to begin upon.

But on the other side it is as evident that the Elements must remain pure in every compounded body in such extreme small parts as we use to call atomes: for if they did not, the variety of bodies would be nothing else, but so many degrees of rarity and density, or so many pure homogeneall Elements, and not bodies composed of heterogeneall parts: and consequently would not be able to shew that variety of parts which we see in bodies, nor could produce the complicated effects which proceed from them. And accordingly we are sure that the least parts which our senses can arrive to discover have many varieties in them: even so much that a whole living creature (whose organically parts must needs be of exceeding different natures) may be so little, as unto

our eyes to seem indivisible; we not distinguishing any difference of parts in it without the help of a multiplying glasse: as in the least kind of mites, and in wormes picked out of childrens hands we daily experience. So as it is evident that no sensible part can be unmingled. But then again, when we call to mind how we have shewed that the qualities which we find in bodies do result out of the composition, and mixtion of the Elements, we must needs conclude, that they must of necessity remain in their own essences in the mixed body. And so out of the whole discourse, determine that they are not there in any visible quantity, but in those least atomes, that are too subtile for our senses to discern. Which position we do not understand so Metaphysically as to say that their substantiall forms remain actually in the mixed body; but onely that their accidentall qualities are found in the compound; remitting that other question unto Metaphysicians (those spirituall Anatomists) to decide.

CHAP. XVII.

Of Rarefaction and Condensation, the two first motions of particular bodies.

Our intension in this discourse, concerning the natures and motions of bodies, aiming no further then at the discovery of what is or may be done by corporall Agents; thereby to determine what is the work of inmaterial & spirituall substances; it cannot be expected at our hands that we should deliver here an intire and complete body of naturall Philosophy. But onely that we should take so much of it in our way, as is needfull to carry us with truth and evidence to our journeyes end. It belongeth not then to us to meddle with those sublime contemplations which search into the nature of the vast Universe, and that determine the unity and limitation of it; and that shew by what strings, and upon pinnes, and wheels, and hinges, the whole world moveth: and that from thence do ascend unto an awfull acknowledgement and humble admiration of the primary cause; from whence, and of which, both the being of it, and the beginning of the first motion; and the continuance of all others doth proceed and depend.

Nor indeed would it be to the purpose for any man to sail in

I.

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this Ocean, and to begin a new voyage of navigation upon it: unlesse he were assured, he had ballast enough in his ship to make her sink deep into the water and to carry her steddily through those unruly waves; and that he were furnished with skill & provision sufficient to go through, without either losing his course by steering after a wrong compasse, or being forced back again with short and obscure relations of discoveries: since others that went out before him, are returned with a large account to such as are able to understand and summe it up. Which surely our learned countreyman, and my best and most honoured friend, and to whom of all men living I am most obliged (for to him I owe that little which I know; and what I have, and shall set down in all this discourse, is but a few sparks kindled by me at his great fire) hath both profoundly, and acutely, and in every regard judiciously performed in his Dialogues of the world.

Our task then (in a lower strain; and more proportionate to so weak shoulders) is to look no further then among those bodies we converse withall. Of which, having declared by what course and engines nature governeth their common motions, that are found even in the Elements, and from thence are derived to all bodies composed of them; we intend now to consider such motions as accompany divers particular bodies, and are much admired by whosoever understandeth not the causes of them.

2.

That bodies may be rarified, both by outward and inward heat; and how this is performed.

To begin from the easiest and most connexed with the actions of the Elements, the handsell of our labour will light upon the motions of *Rarefaction and Condensation*, as they are the passions of mixed bodies. And first for Rarefaction; we may remember how it proceedeth originally from fire, and dependeth of heat; as is declared in the former chapter: and wheresoever we find Rarefaction, we may be confident the body which suffereth it, is not without fire working upon it. From hence we may gather, that when the aire imprisoned in a baloon or bladder, swellets against what containeth it; and stretcheth its case, and seeketh to break out; this effect must proceed from fire or heat (though we see not the fire) working either within the very bowels of the aire, or without, by pressing upon what containeth it, and so making it self a way unto it.

And that this latter way is able to work this effect, may be:

be convinced by the contrary effect from a contrary cause: for take a bladder stretched out unto its greatest extent by aire shut up within it; and hang it in a cold place; and you will see it presently contract it self into a lesse roome; and the bladder will grow wrinckled and become too big for the aire within it. But for immediate proof of this position, we see that the addition of a very small degree of heat, rarifieth the aire in a weather-glasse, (the aire receiving the impression of heat, sooner then water) and so maketh it extend it self into a greater place; and consequently, it presseth upon the water; and forceth it down into a lesse roome then formerly it possessed. And likewise we see quicksilver and other liquors, if they be shut up in glasses close stopped and set in sufficient heat (and a little is sufficient for this effect) they will swell and fill their glasses; and at the last break them, rather then not find a way to give themselves more roome; which is then grown too straight in the glasse, by reason of the rarefaction of the liquors by the fire working upon them.

Now again; that this effect may be wrought by the inward heat, that is enclosed in the bowels of the substance thus shut up; both reason and experience do assure us: for, they teach us that if a body which is not extremely compacted, but that by its looseness is easily divisible into little parts (such a one as wine, or other spirituall liquors) be inclosed in a vessell; the little atomes that perpetually move up and down in every space of the whole world, making their way through every body, will set on work the little parts, in the wine for example, to play their game: so that the hot and light parts (if they be many) not enduring to be compressed and kept in by the heavie and cold ones, do seek to break out with force; and till they can free themselves from the dense ones that would imprison them they carry them along with them, and make them to swell out as well as themselves.

Now if they be kept in by the vessell, so that they have not play enough; they drive the dense ones (like so many little hammers or wedges) against the sides of it, and at the length do break it, and so do make themselves way, to a larger roome. But if they have vent, the more fiery hot spirits fly away, & leave the other grosser parts quiet and at rest. On the other side if the hot and light parts in a liquor be not many nor very active, and the vessell be so full that the parts have not free scope to remove

and make way for one another, there will not follow any great effect in this kind: as we see in bottled beer or ale, that worketh little, unlesse there be some space left empty, in the bottle. And again; if the vessell be very much too big for the liquor in it, the fiery parts find room, first to swell up the heavy ones; and at the length to get out from them, though the vessell be close stopped; for they have scope enough to float up and down between the surface of the liquor, and the roof of the vessell.

And this is the reason that if a little beer or small wine be left long in a great cask, be it never so close stopped, it will in time grow dead. And then, if at the opening of the bung (after the cask hath been long unstirred) you hold a candle close to it, you shall at the instant see a flash of flame environing the vent. Which is no other thing, but the subtil spirits that parting from the beer or wine, have left it dead; and flying abroad as soon as they are permitted, are set on fire by the flame that they meet with in their journey, as being more combustible (because more subtil) then that spirit of wine which is kept in form of liquor: and yet that likewise (though much grosser) is set on fire by the touch of flame. And this happeneth not onely to wine, and beer, or ale, but even to water. As dayly experience sheweth in the east Indian ships, that having been 3 or 6 years at sea, when they open some of their casks of Thames water in their return homewards (for they keep that water till the last; as being their best and most durable; and that groweth lighter and purer, by the often putrifyings through violent motions in storms, every one of which maketh new grosse and earthy parts fall down to the bottome, and other volatile ones ascend to the top;) a flame is seen about their bungs if a candle be near, as we said before of wine.

And to proceed, with confirming this doctrine by further experience; we dayly see that the little parts of heat being agitated and brought into motion in any body; they enter and pierce into other parts, & incorporate themselves with them, and set them on fire if they be capable thereof: as we see in wet hay or flax laid together in great quantity. And if they be not capable of taking fire, then they carry them with them to the outside; & when they can transport them no further, part flies away, & other part staves with

with them: as we see in new beer or ale, & in must of wine; in w^{ch}, a substance usually called the mother, is wrought up to the top.

Which in wine, will at the last be converted into Tartar; when the spirits that are very volatile, are flown away; and do leave those parts from whence they have evaporated, more grosse and earthy then the others, where the grosser and subtiler parts continue still mixed. But in beer or rather in ale; this mother, which in them we call barm, will continue longer in the same consistence, and with the same qualities; for the spirits of it are not so fiery that they must presently leave the body they have incorporated themselves withall; nor are hot enough to bake it into a hard consistence. And therefore bakers make use of it to raise their bread; which neither it will do, unlesse it be kept from cold; both which, are evident signes that it works in force of heat; and consequently, that it continueth still a hot & light substance.

And again we see that after wine or beer hath wrought once, a violent motion will make it work anew. As is dayly seen in great lightnings and in thunder, and by much rocking of them; for such motion rarifieth, and consequently heatech them: partly by separating the little parts of the liquour, which were before as glewed together, and therefore lay quietly; but now, by their pulling asunder, and by the liquours growing thereby more loose then it was, they have freedome to play up and down; and partly by beating one part against another; which breaketh and divideth them into lesser atomes, & so bringeth some of them into the state of fire; which you may remember, is nothing else but a body brought into such a degree of littlenesse and rarity of its parts.

And this is the reason why such hard and drie bodies as have an unctuous substance in them, are by motion either easily set on fire, or at the least, fire is easily gotten out of them. As happeneth in flints, and in divers other stones, which yield fire when they are stricken; and if presently after you smell unto them, you shall perceive an odour of brimstone and of burning which is a certain signe that the motion did convert into fire the naturall brimstone that was mingled with the flint, and whose denser parts were grown cold, and so stuck to the stone. And in like manner, the ivywood and divers others, as also the Indian canes (which from thence are called firecanes) being rubbed with some other stick of the same nature; if they be first very dry, will

of themselves set on fire: and the like will happen to coach-wheels in the summer if they be overheated with motion.

3.
Of the great
effects of Rare-
faction.

To conclude our discourse of rarefaction, we may look a little into the power and efficacy of it; which is no where to be seen so clearly as in fire. And as fire is the generall cause of rarefaction, so is it of all bodies that which is most rarified. And therefore it is no marvail if its effects be the greatest that are in nature, seeing it is the proper operation of the most active Element. The wonderfull force of it we dayly see in thunder, in guns, in granado's, and in mines; of which, continuall experience, as well as severall histories witnesseth little lesse then miracles. Leaving them to the remarks of curious persons, we will onely look into the way by which so main effects do proceed from causes that appear so slender.

It is evident that fire (as we have said before) dilateth it self spherically; as nature sheweth us manifestly in bubbles of boyling water, and of milk, and generally of such substances as are of a viscuous composition; for those bubbles being round, do assure us that the cause which made them, did equally dilate them from the center unto all parts. Now then remembring the infinite multiplication which is in fire, we may conceive that when a grain of gun-powder is turned thereinto, there are so many little bubbles of a viscuous substance one backing another with great celerity, as there are parts of fire more then there were of gun-powder. And if we make a computation of the number and of the celerity of these bubbles, we shall find that although every one of them single do seem to be of an inconsiderable force, yet the whole number of them together, will exceed the resistance of the body moved or broken by them: especially, if we note, that when hard substances have not time allowed them to yield, they break the sooner. And then we shall not so much admire the extremities we see acted by these means.

4.
The first man-
ner of conden-
sation, by heat.

Thus having looked into the nature of rarefaction, and traced the progresse of it from the motion of the sun & fire; in the next place we are to examine the nature of condensation. And we shall oftentimes find it likewise an effect of the same cause otherwise working: for there being two different wayes to dry any wet thing; the one, by taking away that joyce which maketh a body liquid; the other, by putting more drought to the wet body,

dy, that it may imbibe the moisture; this latter way doth, as well as the former, condense a body: for by the close sticking of wet to dry, the most part of condensation is effected in compounded bodies.

The first of these ways doth properly and immediately proceed from heat; for heat entering into a body, incorporateth it self with the moist and viscuous parts it findeth there: as purging medicines do with the humours they work upon; which when the stomach can no longer entertain (by reason of their unruly motions in wrestling together) they are both ejected grappling with one another; and the place of their contention is thus, by the supervenience of a guest of a contrary nature (that will not stay long there) purged from the superabundance of the former ones that annoyed it. Even so, the fire that is greedily drunk up by the watry and viscuous parts of a compounded body; and whose activity and restlesse nature will not endure to be long imprisoned there, quickly pierceth quite through the body it entereth into, and after a while streameth out at the opposite side, as fast as it entered on the side next to it, and carrieth away with it those glewy parts it is incorporated with: and by their absence, leaveth the body they part from, dryer then at the first it was.

Which course we may observe in sirrups that are boyled to a consistence, and in broths that are consumed unto a jelly: over which, whiles they are making by the fire under them, you see a great steam; which is, the watry parts that being incorporated with fire, flie away in smoke. Likewise when the sea-water is condensed into salt, you see it is an effect of the sunne or fire that exhaleth or boyleth away all the palpable moisture. And so when wet clothes are hanged either in the sunne or at the fire, we see a smoke about the clothes, and heat within them; which being all drawn out from them, they become dry.

And this deserveth a particular note, that although they should be not quite dry, when you take them from the fire; yet by then they are cool they will be dry: for the fire that is in them when they are removed from the main stock of fire, flying away carrieth with it the moisture that was incorporated with it: and therefore whiles they were hot, that is, whiles the fire was in them, they must also be moist; because the fire and the moisture were

grown to be one body: & could not become through dry with that measure of fire, (for more would have dried them, even while they were hot) untill they were also grown through cold. And in like manner, sirupes, hydromels, gellies, and the like grow much thicker after they are taken off from the fire, then they were upon the fire, and much of their humidity flieth away with the fire, in their cooling, whereby they lessen much of their quantity, even after the outward fire hath ceased from working upon them.

Now if the moist parts, that remain after the drying, be by the heat well incorporated in the dry parts; and so do occasion the dry parts to stick close together; then that body is condensed, and will (to the proportion of it) be heavier in a lesse bulk; as we see that metalls are heavier then stones.

5.
The second
manner of con-
denfation by
cold.

Although this effect be in these examples wrought by heat, yet generally speaking it is more proper to cold: which is the second way of drying a moist body. As when in Greenland, the extreme cold freezeth the whalefishers beer into ice, so that the stewards divide it with axes and wedges, and deliver their portions of drink to their ships company, and their shallops gings, in their bare hands: but in the innermost part of the butte, they find some quantity of very strong liquour, not inferiour to moderate spirit of wine. At the first, before custome had made it familiar unto them, they wondered that every time they drew at the tap, when first it came from their ships to the shore (for the heat of the hold would not let it freeze) no liquour would come, unlesse they new tapped it with a longer gimlet: but they thought that pains well recompenced, by finding it in the tast to grow stronger and stronger; till at the last, their longest gimlets would bring nothing out; & yet the vessell not a quarter drawn off; which obliged them then to stave the cask, that so they might make use of the substance that remained.

The reason of this, is evident: that cold seeking to condense the beer by mingling its dry and cold parts with it, those that would indure this mixture, were imbibed and shrunk up by them. But the other rare and hot parts that were squeezed out by the dense ones which entered to congeal the beer, and were forced into the middle of the vessel (which was the furthest part for them to retire unto, from their invironing enemies) did conserve

serve themselves in their liquid form, in defiance of the assaulting cold; whiles their fellows, remaining by their departure more grosse and earthy then they were before, yielded to the conquerour, they could not shift away from, and so were dried and condensed in ice: which when the mariners thawed, they found it like faire water, without any spirits in it or comforting heat to the stomach.

This manner of condensation, which we have described in the freezing of beer, is the way most practised by nature; I mean, for immediate condensation (for condensation is secondarily, wheresoever there is rarefaction which we have determined to be an effect of heat.) And the course of it is: that a multitude of earthy and dry bodies being driven against any liquor, they easily divide it, by means of their density, their drynesse, and their littleness (all which in this case do accompany one another; and are by us determined to be powerfull dividers;) and when they are gotten into it, they partly suck into their own pores the wet and diffused parts of the liquide body; and partly they make them (when themselves are full) stick fast to their dry sides, and become as a glew to hold themselves strongly together. And thus they dry up the liquor; and by the naturall pressing of gravity they contract it into a lesser room. No otherwise then when we force much wind or water into a bottle; and by pressing it more and more, make it lye closer then of its own nature it would do. Or rather, as when ashes being mingled with water; both those substances do stick so close to one another, that they take up lesse room then they did each apart.

This is the method of frosts, and of snow, and of ice, both naturall and artificiall; for in naturall freezing, ordinarily the north or northeast wind by its force bringeth and driveth into ours liquours, such earthy bodies as it hath gathered from rocks covered with snow; which being mixed with the light vapours whereof the wind is made, do easily find way into the liquors, and then they dry them into that consistence which we call ice. Which in token of the wind it hath in it, swimmeth upon the water, and in the vessell where it is made, riseth higher then the water did whereof it is composed: and ordinarily is breaketh from the sides of the vessell, so giving way to more wind to come in, and freeze deeper and thicker.

3.

That yce is not
water rarified
but condensed.

But because Galileus, *Nel discorso intorno alle cose che stanno in su l'acqua, pag. 4.* was of opinion that yce was water rarified, and not condensed; we must not passe over this verity; without maintaining it against the opposition of so powerfull an adversary. His arguments are, first that yce taketh up more place then the water did of which it was made; which is against the nature of condensation. Secondly, that quantity for quantity yce is lighter then water; whereas things that are more dense are proportionally more heavy. And lastly, that yce swimmeth in water, whereas we have often taught, that the more dense descendeth in the more rare.

Now to reply to these arguments, we say first, that we would gladly know how he did to measure the quantity of the yce, with the quantity of the water of which it was made; and then when he hath shewed it, and shewed withall that yce holdeth more place then water; we must tell him that his experiment concludeth nothing against our doctrine, because there is an addition of other bodies mingled with the water to make yce of it as we touched above; and therefore that compound may well take up a greater place then the water alone did, and yet be denser then it; and the water also be denser then it was.

And that other bodies do come into the water and are mingled with it, is evident out of the exceeding coldness of aire, or some very cold wind; one of which two never misseth to reigne whensoever the water freezeth: and both of them do argue great store of little earthy dry bodies abounding in them, which sweeping over all those that lie in their way and course, must of necessity be mixed with such as give them admittance; which water doth very easily. And accordingly we see that when in the freezing of water the yce groweth any thing deep, it either shrinketh about the borders, or at the least lieth very loose, so as we cannot doubt but that there is a free passage for more of such subtile bodies to get still to the water, and freez it deeper.

To his second argument, we ask how he knoweth that yce quantity for quantity, is lighter then water? For although of a sponge that is full of water, it be easie to know what the sponge weigheth, and what the water that was soked into it, because we can part the one of them from the other, and keep each apart to examine their weights, yet to the like between yce and water,

water, if yce be throughout full of aire (as of necessity it must be) we believe impossible. And therefore it may be lighter in the bulk then water, by reason of the great pores caused in it, through the shrinking up of the parts of water together (which pores must then necessarily be filled with aire) & yet every part by it self (in which no aire is) be heavier then so much water.

And by this it appeareth that his last argument (grounded upon the swimming of yce in water) hath no more force then if he would prove that an yron or an earthen dish, were lighter, & consequently more rare then water, because it swimmeth upon it; which is an effect of the aires being contained in the belly of it (as it is in yce) not a signe of the metalls being more rare then water.

Whereas on the contrary side, the proof is positive and clear for us; for it cannot be denied, but that the mingling of the water with other bodies more dense then it, must of necessity make the compound and also the water it self become more dense then it was alone. And accordingly we see, that yce half thawed (for then much of the aire is driven out, and the water beginneth to fill the pores wherein the aire resided before) sinketh to the bottom: as an iron dish with holes in it (whereby the water might get into it) would do. And besides, we see that water is more diaphanous then yce, and yce more consistent then water. Therefore I hope we shall be excused, if in this particular we be of a contrary opinion to this great personage.

But to return unto the thrid of our discourse. The same that passeth here before us, passeth also in the sky with snow, hail, rain, and wind. Which that we may the better understand, let us consider how winds are made: for they have a main influence into all the rest. When the sunne by some particular occurrent raiseth great multitudes of atomes from some one place, and they either by the attraction of the sun, or by some other occasion, do take their course a certain way; this motion of those atomes we call a wind: which according to the continuance of the matter from whence these atomes rise, endureth a longer or a shorter time, and goeth a farther or a shorter way; like a river, or rather like those eruptions of waters, which in the Northern parts of England they call *Gypsies*: the which do break out at uncertain times, and upon uncertain causes, and flow likewise with

7.
How wind,
snow, and hail
are made; and
wind by rain
allayed.

an uncertain duration. So these winds being composed of bodies in a determinate proportion heavier then the aire, do run their course from their height to the ground, where they are supported (as water is by the floore of its channell) whiles they perform their carrear; that is, untill they be wasted either by the drawing of the sun, or by their sticking & incorporating into grosser bodies.

Some of these winds according to the complexion of the body out of which they are extracted, are dry; as those which come from barren mountains covered with snow: others are moist, as those that come out of marshy or watry places: others have other qualities; as of heat, or cold, of wholesomnesse, or unwholesomnesse, and the like; partly from the source, and partly from the bodies they are mingled with in their way.

Such then being the nature and origine of winds; if a cold one do meet in the aire with that moist body whereof otherwise rain would have been made, it changeth that moist body into snow or into hail; if a dry wind meet with a wet body it maketh it more dry, and so hindreth the rain that was likely to be: but if the wet body overcome the dry wind, it bringeth the wind down along with it; as we see when a shoure of rain allaieth a great wind.

And that all this is so, experience will in some particulars instruct us as well as reason, fro whence the rest may be evidently inferred. For we see that those who in imitation of nature would convert water into ice, do take snow or ice & mingle it with some active dry body, that may force the cold parts of the snow from it; & then they set the water (in some fit vessel) in the way that those little bodies are to take, which by that means entring into it, do strait incorporate themselves therewith, & of a sudden do convert it into ice. W^{ch} proceffe you may easily try, by mingling salt armoniack with the snow; but much more powerfully by setting the snow over the fire, whiles the glasse of water to be congealed stands in it after the manner of an egge in salt. And thus fire it self, though it be the enemy and destroyer of all cold, is made the instrument of freezing. And the same reason holdeth in the cooling of wine with snow or yce, when after it hath been a competent time in the snow, they whose charge it is, do use to give the vessel that containeth the wine, three or foure turns in the snow; so to mingle through the whole body of the wine, the

cold

cold received first but in the outward parts of it, and by pressing, to make that without have a more forcible ingression.

But the whole doctrine of Meteors is so amply, so ingeniously, and so exactly performed by that never enough praised Gentleman Monsieur Des Cartes in his Meteorologicall discourses; as I should wrong my self and my Reader, if I dwelled any longer upon this subject. And whose Physicall discourses, had they been divulged before I had entred upon this work, I am perswaded would have excused the greatest part of my pains in delivering the nature of bodies.

It were a fault to passe from treating of condensation, without noting so ordinary an effect of it as is the joyning together of parts of the same body, or of divers bodies. In which we see for the most part that the solide bodies which are to be joyned together, are first either heated or moistened, that is, they are rarified: and then they are left to cold aire or to other cold bodies to thicken and condense (as above we mentioned of syrups and jellies;) and so they are brought to stick firmly together. In the like manner we see that when two metalls are heated till they be almost brought to running, and then are pressed together by the hammer, they become one continued body. The like we see in glasse, the like in wax, and in divers other things. On the contrary side; when a broken stone is to be pieced together, the pieces of it must be wetted, and the ciment must be likewise moistened, and then joyning them aptly, and drying them, they stick fast together. Grew is moistened, that it may by drying afterwards hold pieces of wood together. And the spectacle-makers have a composition which must be both heated and moistened, to joyn unto handles of wood the glasses which they are to grind. And broken glasses are cimented with cheese and chalk or with garlick.

All these effects our sense evidently sheweth us, arise out of condensation; but to our reason it belongeth to examine particularly by what steps they are performed. First then we know that heat doth subtilize the little bodies which are in the pores of the heated body; and partly also it openeth the pores of the body it self, if it be of a nature that permitteth it; as it seemeth those bodies are, which by heat are mollified or are liquefactible. Again, we know that moisture is more subtil to enter into small creeks than

8.

How parts of the same or divers bodies are joyned more strongly together by condensation.

then dry bodies are; especially when it is pressed; for then it will be divided into very little parts, and will fill up every little chink; and neverthelesse if it be of a grosse and viscusous nature, all the parts of it will stick together. Out of these two properties we have, that since every body hath a kind of orb of its own exhalations, or vapours round about it self (as is before declared,) the vapours which are about one of the bodies, will more strongly and solidly (that is, in more abundant & greater parts) enter into the pores of the other body against which it is pressed when they are opened and dilated: and thus they becoming common to both bodies, by flowing from the one, and streaming into the other, and sticking to them both will make them stick to one another. And then as they grow cold and dry, these little parts shrink on both sides; and by their shrinking draw the bodies together; and withall do leave greater pores by their being compressed together, then were there when by heat and moysture they were dilated; into which pores the circumstance cold parts do enter, and thereby do as it were wedge in the others; and consequently do make them hold firmly together the bodies which they joyn.

But if art or nature should apply to this juncture any liquor or vapour, which had the nature and power to insinuate it self more efficaciously to one of these bodies, then the glew which was between them did; of necessity in this case these bodies must fall in pieces. And so it happeneth in the separation of metalls by corrosive waters; as also in the precipitation of metalls or of salts when they are dissolved in such corrosive waters, by means of other metalls or salts of a different nature: in both which cases the entrance of a latter body that penetrateth more strongly, and uniteth it self to one of the joynded bodies but not to the other, teareth them asunder, and that which the piercing body rejecteth, falleth into little pieces; and if formerly it were joynded with the liquor, it is then precipitated down from it in a dust

9.
Vacuities cannot be the reason why water impregnated to the full with one kind of salt, will notwithstanding receive more of another.

Out of which discourse we may resolve the question of that learned and ingenious man Petrus Gassendus; who by experience found, that water impregnated to fulnesse with ordinary salt, would yet receive a quantity of other salt; and when it would imbibe no more of that, would neverthelesse take into it a proportion of a third; and so of severall kinds of salts one af-

ter another: which effect he attributed to vacuities or porous spaces of divers figures, that he conceived to be in the water; whereof some were fit for the figure of one salt, and some for the figure of another. Very ingeniously; yet if I misse not my mark most assuredly he hath missed his.

For first, how could he attribute divers sorts of vacuities to water without giving it divers figures? And this would be against his own discourse, by which every body should have one determinate naturall figure.

Secondly, I would ask him if he measured his water after every salting? and if he did, whether he did not find the quantity greater, then before that salt was dissolved in it? Which if he did (as without doubt he must) then he might safely conclude that his salts were not received in vacuities; but that the very substance of the water gave them place, and so increased by the receiving of them.

Thirdly, seeing that in his doctrine every substance hath a particular figure; we must allow a strange multitude of different shapes of vacuities to be naturally in water; if we will have every different substance wherewith it may be impregnated (by making decoctions, extractions, solutions, and the like) to find a fit vacancy in the water to lodge it self in. What a difform net with a strange variety of meshes would this be? And indeed how extremely incapable must it be of the quantity of every various kind of vacancy that you will find must be in it; if in every solution of one particular substance, you calculate the proportion between it and the water that dissolveth it, and then multiply it according to the number of severall kinds of substances that may be dissolved in water? By this proceeding, you will find the vacuities to exceed infinitely the whole body of the water; even so much that it could not afford subtile thrids enough to hold it self together.

Fourthly, if this doctrine were true it would never happen that one body or salt should precipitate down to the bottome of the water, by the solution of another in it, w^{ch} every Alchymist knoweth, never faileth in due circumstances: for seeing that the body which precipitateth, and the other which remaineth dissolved in the water, are of different figures, and therefore do require different vacuities, they might both of them have kept their pla-

ces in the water, without thrusting one another out of it.

Lastly, this doctrine giveth no account why one part of salt is separated from another by being put in the water, and why the parts are there kept so separated, which is the whole effect of that motion which we call dissolution.

10.

The true reason
of the former
eff. &

The true reason therefore of this effect, is (as I conceive) that one salt maketh the water apt to receive another; for the lighter salt being incorporated with the water, maketh the water more proper to stick unto an heavier, and by dividing the small parts of it to bear them up, that otherwise would have sunk in it. The truth and reason of which will appear more plain, if at every joynt we observe the particular steps of every salts solution. As soon as you put the first salt into the water, it fallerth down presently to the bottome of it; and as the water doth by its humidity pierce by degrees the little joynts of this salt, so the small parts of it are by little and little separated from one another, and united to parts of water. And so infusing more and more salt, this progresse will continue, untill every part of water is incorporated with some part of salt; and then, the water can no longer work of it self but in conjunction to the salt with which it is united. After which, if more salt of the same kind be put into the water; that water so impregnated, will not be able to divide it; because it hath not any so subtile parts left, as are able to enter between the joynts of a salt so closely compacted: but may be compared to that salt, as a thing of equall driness with it; and therefore is unapt to moisten and to pierce it.

But if you put into this compound of salt and water, another kind of salt that is of a stronger and a drier nature then the former, & whose parts are more grossely united; then the first salt dissolved in the water, will be able to get in betwixt the joynts of the grosser salt, & will divide it into little parts; and will incorporate his already composed parts of salt and water into a decomposed of two salts and water; untill all his parts be anew impregnated with the second grosser salt; as before, the pure water was with the first subtiler salt. And so it will proceed on, if proportionate bodies be joyned, untill the dissolving composition do grow into a thick body.

Unto which discourse we may adde, that when the water is so fully impregnated with the first salt, as it will receive no more,

remaining in the temper it is in; yet if it be heated, it will then afresh dissolve more of the same kind. Which sheweth, that the reason of its giving over to dissolve, is for want of having the water divided into parts little enough to stick unto more salt: which, as in this case the fire doth; so peradventure in the other, the acrimoniousness of the salt doth it.

And this is sufficient to give curious wits occasion by making further experiments, to search out the truth of this matter. Onely we may note what hapneth in most of the experiencies we have mentoned; to wit, that things of the same nature do joyn better and more easily then others that are more estranged from one another. Which is very agreeable to reason; seeing that if nature do intend to have things consist long together, she must fit them for such consistence.

Which seemeth to proceed out of their agreement in foure qualities; first, in weight for bodies of divers degrees in weight, if they be at liberty, do seek divers places; and consequently substances of like weight, must of necessity find one another out, and croud together; as we have shewed, it is the nature of heat to make them do: now it is apparent that things of one nature, must in equall parts have the same or a near proportion of weight, seeing that in their composition; they must have the same proportion of Elements.

The second reason of the consistence of bodies together, that are of the same nature is, the agreement of their liquid parts, in the same degree of rarity and density: for as it is the nature of quantity in common to make all parts be one quantity; so it is the nature of the degrees of quantity, when two parts do meet that are of the same degree, to make them one in that degree of quantity; which is, to make them stick together in that degree of sticking, which the degree of density that is common to them both, maketh of its own nature. Whereas, parts of different densities, cannot have this reason of sticking; though, peradventure they may upon some other ground, have some more efficacious one. And in this manner, the like humid parts of two bodies, becoming one, the holes or receptacles in which those humide parts are contained must also needs be united.

The third reason is the agreeable proportion, which their severall figures have in respect of one another: for if any humidi-

II.

The reason why bodies of the same nature do joyn more easily together, then others.

ty be extracted out of a mixed body, especially, by the virtue of fire; it must have left pores of such figures, as the humidity that is drawn out of them, is apt to be cut into (for every humide body not being absolutely humide, but having certain dry parts mixed with it, is more apt for one kind of figure and greatnesse, then for another;) and by consequence, whensoever that humidity shall meet again with the body it was severed from; it will easily run through and into it all, and will fill exactly the cavities and pores it possessed before.

The last quality, in which bodies that are to consist long together, do agree, is the bignesse of the humide and dry parts of the same body: for if the humide parts be too big for the dry ones, it is clear that the dry ones must needs hang loosely together by them; because their glew is in too great a quantity. But if the humide parts be too little for the dry ones, then of necessity some portion of every little dry part must be unfurnisht of glew, by means whereof to stick unto his fellow; and so the sticking parts not being conveniently proportioned to one another, their adhesion cannot be so solid as if each of them were exactly fitted to his fellow.

CHAP. XVIII.

Of another motion belonging to particular bodies, called Attraction; and of certain operations, termed Magicall.

I. **H**AVING thus ended the two motions of rarefaction and of condensation; the next that offer themselves, are the local motions which some bodies have unto others. These are sometimes performed by a plain force in the body towards which the motion is: and other whiles by a hidden cause, which is not so easily discerned. The first, is chiefly that which is ordinarily said to be done by the force of nature to hinder *vacuum*, and is much practised by nature; as in drawing our breath, in sucking, and in many other naturall operations, which are imitated by art in making of pumpes, syphons, and such other instruments; and in that admirable experiment of taking up a heavy marble stone merely by another lying flat and smoothly upon it, without any other connexion of the two stones together; as also by that sport of boyes, when they spread a thin moistned leather upon a smooth broad stone, and presse it all over close to it, and then by pulling of a string fastned at the middle of the leather,

What Attraction is, and from whence it proceeds.

leather, they draw up likewise the heavy stone. In all which, the first cause of the motion proceedeth from that body towards which the motion is made. And therefore is properly called *Attraction*.

For the better understanding and declaring of which, let us suppose two marble stones, very broad and exceeding smoothly polished to be laid one flat upon the other: and let there be a ring fastned at the back part of the uppermost stone; and exactly in the middle of it. Then by that ring, pull it up perpendicularly and steadily, and the undermost will follow sticking fast to the overmost; and though they were not very perfectly polished, yet the nethermost would follow for a while, if the ring be suddenly plucked up; but then it will soon fall down again. Now this plainly sheweth that the cause of their sticking so strongly together, when both the stones are very well polished, is for that nothing can well enter between them to part them; and so, it is reduced to the shortness of the aire that is betwixt them: which not being capable of so great an expansion, nor admitting to be divided thickways so much as is necessary to fill the first growing distance, between the two stones till new air findeth a course thither (that so, the swelling of the one, may hinder vacuity, till the other come into the rescue;) the two stones must needs stick together to certain limits; which limits will depend of the proportion that is between the weight, and the continuity of the nethermost stone.

And when we have examined this, we shall understand in what sense it is meant that *Nature abhorreth from Vacuity*, and what means she useth to avoid it. For, to put it as an enemy that nature fighteth against; or to discourse of effects that would follow from it, in case it were admitted, is a great mistake, and a lost labour; seeing it is nothing; and therefore, can do nothing: but is merely a forme of expression to declare in short nothing else but that it is a contradiction, or implication in termes, and an impossibility in nature, for yacuity to have, or to be supposed to have a *Being*.

Thus then, since in our case, after we have cast all about, we can pitch upon nothing to be considered, but that the two stones do touch one another, and that they are weighty; we must apply our selves onely to reflect upon the effects proceeding from these two causes, their contiguity and their heaviness; and we shall find

2.

The true sense of the Maxime, that *Nature abhorreth from vacuity*.

that as the one of them, namely the weight, hindereth the undermost from following the uppermost, so, contiguity obligeth it unto that course; and according as the one overcometh the other, so will this action be continued or interrupted.

Now that contiguity of substances do make one follow another, is evident by what our Masters in Metaphysicks teach us; when they shew that without this effect no motion at all could be made in the world, nor no reason could be given, for those motions we daily see. For since the nature of quantity is such, that whensoever there is nothing between two parts of it, they must needs touch and adhere and joyn to one another, (for how should they be kept asunder when there is nothing between them to part them?) if you pull one part away, either some new substance must come to be close unto that which removeth; or else the other which was formerly close to it, must still be close to it, and so follow it; for if nothing do come between, it is still close to it. Thus then, it being necessary that something must be joyned close to every thing; vacuity, (which is nothing) is excluded from having any being in nature.

And when we say that one body must follow another to avoid vacuity; the meaning is, that under the necessity of a contradiction they must follow one another, and that they cannot do otherwise. For it would be a contradiction to say that nothing were between two things and yet that they are not joyned close to one another. And therefore if you should say it, you would in other words say, they are close together, and they are not close together. In like manner, to say that vacuity is any where, is a pure contradiction; for vacuity being nothing hath no *Being* at all: and yet by those words it is said to be in such a place; so that they affirm it *to be* and *not to be*, at the same time.

3.
The true reason
of attraction.

But now let us examine if there be no means to avoid this contradiction and vacuity, other then by the adhesion, and following of one body upon the motion of another, that is closely joyned to it and every where contiguous. For sense is not easily quieted with such Metaphysicall contemplations, that seem to repugne against her dictaments; and therefore for her satisfaction we can do no lesse then give her leave to range about, and cast all waies in hope of finding some one that may better content her: which when she findeth that she cannot she will the lesse repine

to yield her assent to the rigorous sequels and proofs of reason.

In this difficulty then, after turning on every side, I for my part can discern no pretence of probability, in any other means than in pulling down the lower stone by one corner; that so there may be a gaping between the two stones, to let in aire by little and little. And in this case you may say that by the intervention of aire, vacuity is hindered, and yet the lower stone is left at liberty to follow its own naturall inclination, and be governed by its weight. But indeed, if you consider the matter well, you will find that the doing this, requireth a much greater force, then to have the lower stone follow the upper: for it cannot gape in a straight line, to let in aire; since in that position, it must open at the bottom where the angle is made, at the same time that it openeth at the mouth: and then aire requiruing time to passe from the edges to the bottome, it must in the mean while fall into the contradiction of vacuity. So that if it should open to let in aire; the stone, to compass that effect, must bend, in such sort as wood doth when a wedge is put into it to cleave it.

Judge then what force it must be that should make hard marble of a great thicknesse bend like a wand; & whether it would not rather break and slide off, then do so: you will allow that a much lesse, will raise up the lower stone together with the uppermost. It must then of necessity fall out, that it will follow it, if it be moved perpendicularly upwards. And the like effect will be though, it should be raised at oblique angles, so that the lowermost edge do rest all the way upon something that may hinder the inferiour stone from sliding aside from the uppermost.

And this is the very case of all those other experiments of art and nature, which we have mentioned above: for the reason holdeth as well in water and liquide things; as in solid bodies, untill the weight of the liquid body overcome the continuity of it: for then, the thrid breaketh, and it will ascend no higher.

Which height, Galileo telleth us from the workmen in the Arsenall of Venice, is 40. foot; if the water be drawn up in a close pipe, in which the advantage of the sides helpeth the ascent. But others say that the invention is enlarged, and that water may be dravvn to vwhat height one pleaseth. Howsoever, the force which nature applieth to maintain the continuity of quantity, can have no limit, seeing it is grounded upon contradiction.

4.

Water may be brought by the force of attraction to what height soever.

And therefore Galileo was much mistaken, when he thought to make an instrument whereby to discover the limits of this force.

We may then conclude, that the breaking of the water must depend from the strength of other causes. As for example, when the gravity is so great by increasing the bulk of the water, that it will either overcome the strength of the pipe, or else make the sucker of the pump rather yield way to aite, then draw up so great a weight: for which defects, if remedies be found, the art may surely be enlarged without end.

5.
The doctrine touching the attraction of water in syphons.

This is particular in a syphon; that when, that arm of it which hâgeth out of the water is lower then the superficies of the water; then, it will run of it self; after it is once set on running by sucking. The reason whereof is, because the weight which is in the water pendant, is greater then the weight of the ascending water; and thereby supplyeth the want of a continuall sucker. But if the nose of that arm that hangeth out of the water, be but even with the water; then the water will stand still in both pipes, or arms of the syphon, after they are filled with sucking. But if by the running out of the water, the outward pipe do grow shorter then to reach as low as the superficies of the water in the fountain from whence it runneth; in this case, the water in each arm of the syphon, will runne back into the fountain.

Withall, it is to be noted, that though the arm which is out of the water be never so long, yet if it reach not lower then the superficies of the fountain; the overquantity and weight of the water there, more then in the other arm, helpeth it nothing to make it runne out. Which is, because the declivity of the other arm overrecompenceth this overweight. Not that the weight in the shorter pipe hath so much force as the weight in the longer pipe: but because it hath more force then the greater weight doth exercise therein its running; for the greatest part of it force, tendeth another way then to the end of the pipe; to wit, perpendicularly towards the center. And so is hindered from effect, by the great sloping or little declivity of the pipe upon which it leaneth.

6.
That the syphon doth not prove water to weigh in its own orb.

But some considering how the water that is in the longer arm of the syphon is more in quantity then the water that is in the other arm of it vvhereat it runneth out, do admire vvhly the greater quantity of water doth not draw back the lesse into the cistern,

cistern, but suffereth it self to be lifted up, and drained away as if it run steeply downwards. And they imagine, that hence may be deduced, that the parts of water in the cistern do not weigh as long as they are within the orb of their own body.

Unto whō we answer; that they should consider how that to have the greater quantity of water, which is in the longer arm of the syphon (which arm is immersed in the water of the cistern) to draw back into the cistern the water which is in the other arm of the syphon that hangeth out in the aire; it must, both raise as much of the water of the cistern as its own bulk is, above the levell which at present the whole bulk of water hath; and withall it must at the same time pull up the water which is in the other arm. Now it is manifest, that these two quantities of water together, are heavier then the water in the sunk arm of the syphon; since one of them single, is equall unto it. And by consequence, the more water in the sunk arm cannot weigh back the lesse water in the hanging arm; since that, to do that, it must at the same time weigh up over and above, as much more in the cistern as it self weigheth.

But turning the argument; I say, that if once the arm of the syphon that is in the aire, be supposed to draw any water, be it never so little, out of the cistern (whether occasioned by sucking or by whatsoever other means) it followeth that as much water as is drawn up, above the levell of the whole bulk in the cistern, must needs presse into the suncken arm from the next adjacent parts, (that is, from the bottom) to supply its emptying; and as much must of it self presse down from above (according to its naturall course, when nothing violenteth it) to rest in the place, that the ascending water (which is lower then it) leaveth at liberty for it to take possession of. And then it cannot be doubted; but that, this descending water, having all its weight in pressing down applied to drive up the rising water in the sunk arm of the syphon; & the water in the other arm of the syphon without, having all its weight in running out applied at the same time to draw up the same water in the sunk arm; this single resistant must yield to their double & mastering force. And consequently, the water in the arm of the syphon that is in the aire, must needs draw the water that is in the other immersed arm as long as the end of its pipe reacheth lower then the levell of the water in the cistern; for so long

long it appeareth by what we have said, it must needs be more weighty; since part of the rising water in the sunk arm of the syphon, is counterpoised by as much descending water in the cistern

And thus it is evident, that out of this experiment it cannot be inferred that parts of water do not weigh within the orb of their own whole: but onely, that two equall parts of water in their own orb (namely that which riseth in the sunken arm, & that which presseth down from the whole bulk in the cistern) are of equall weight and do ballance one another. So that never so little oddes between the two counterpoysing parcels of water which are in the aire must needs make the water run out at that end of the syphon, where the overweight of water is.

7.
Concerning
attraction
caus'd by fire.

The attraction whose cause next to this is most manifest, is that which is made by the force of heat or of fire; for we see that fire ever draweth aire unto it; so notably, that if in a close room there be a good fire, a man that standeth at the door or at the window (especially without) shall hear such a noise that he will think there is a great wind within the chamber. The reason of this attraction is, that fire rarifying the aire which is next unto it; and withall spending it self perpetually, causeth the aire, and his own body mingled together, to flie up through the chimney or by some other passage. Whence it followeth of necessity that the next body must succeed into the place of the body that is flown away. This next body generally is aire, whose mobility and fluidity beyond all other bodies, maketh it of all others the fittest to be drawn; and the more of it that is drawn the more must needs follow. Now if there be floting in this aire any other atomes subject to the current which the aire taketh; they must also come with it to the fire, and by it, must be rarified, and be exported out of that little orb.

Hence it is, that men (with very good reason) do hold that fire aireth a chamber, as we terme it, that is, purifieth it, both because it purifieth it as wind doth by drawing a current of aire into it that sweepeth through it, or by making it purifie it self by motion, as a stream of water doth by running; as also, because those vapours which approach the fire, are burned and dissolved. So that the aire being noisome and unwholesome by reason of its grossenesse, proceeding from its standing unmoved (like a stagnation of dead water, in a marisha place) the fire taketh away that cause of annoyance.

By

By this very rule we learn that other hot things, which participate the nature of fire, must likewise (in other respects) have a resemblance in this quality. And accordingly we see that hot loafs in a bakers shop newly drawn out of the oven, are accounted to draw unto them any infection which is in the aire. The like we say of onyons, & other strong breathing substances; which by their smell shew much heat in them. In like manner it is conceived that pigeons, and rabbits, and cats easily take infection, by reason of their extraordinary warmth which they have in themselves.

And this is confirmed by the practise of Physicians, who use to lay warm pigeons newly killed to the feet, wrists, or heads of sick persons; & young puppies to their stomachs, & sometimes certain hot gums to their navels; to draw out such vapours or humours as infect the body: for the same reason they hang amulets of arsenick, sublimate, dried toads or spiders, about their patients necks, to draw unto them venomous qualities from their bodies. Hence also it is, that if a man be stricken by a viper or a scorpion, they use to break the body of the beast it self that stung him (if they can get it) upon the wound: but if that beast be crawled out of their finding, they do the like by some other venomous creature; as I have seen a bruised toad laid to the biting of a viper. And they manifestly perceive the applyed body, to swell with the poyson sucked out from the wound, and the patient to be relieved and have lesse poyson; in the same manner as by cupping-glasses, the poyson is likewise drawn out from the wound: so that you may see, the reason of both, is the very same; or at the least very like one another. Onely, we are to note, that the proper body of the beast out of which the venome was driven into the wound, is more efficacious then any other to suck it out.

And the like is to be observed in all other kinds, that such vapours as are to be drawn, do come better and incorporate faster in bodies of like nature, then in those which have onely the common conditions of heat and drynesse; the one of which serveth to attract; the other to fasten and incorporate into it self the moisture which the first draweth unto it. So we see that water soketh into a dry body, whence it was extracted, almost inseparably, & is hidden in it; as when it raineth first after hot weather, the ground is presently dried after the showre. Likewise we see

8.

Concerning abstraction made by virtue of hot bodies, amulets &c.

that

that in most ciments, you must mingle a dust of the nature of the things w^{ch} are to be cimented, if you wil have them bind strongly

9.
The naturall
reason given
for divers ope-
rations, esteem-
ed by some to
be magicall.

Out of this discourse, we may yield a reason for those magi-
call operations, which some attribute to the Devils assistance;
peradventure because mans wickednesse hath been more ingeni-
ous then his good will; and so hath found more means to hurt
then to help; nay when he hath arrived some way to help, those
very helps have undergone the same calumny; because of the
likenesse which their operations have to the others. Without
doubt very unjustly, if there be truth in the effects. For where
have we any such good suggestions of the enemy of mākind pro-
posed unto us, that we may with reason believe he would duly,
settledly, and constantly concurre to the help and service of all
those he so much hateth, as he needs do if he be the Authour of
such effects? Or is not a wrong to Almighty God, and to his
carefull instruments; rather to impute unto the Devil the aids
which to some may seem supernaturall, then unto them of whom
we may justly believe & expect such good offices and assistances?
I mean, those operations, both good and bad, which ordinarily
are called *Magneticall*, though peradventure wrongfully, as not
having that property which denominateth the loadstone.

One thing I may assure, that if the reports be true, they have
the perfect imitation of nature in them. As for example; that
the weapons salve, or the sympathetick powder doth require in
the using it, to be conserved in an equall and moderate temper:
and that the weapon which made the wound, or the cloth upon
which the bloud remaineth that issued from it, be orderly and
frequently dressed; or else the wounded person will not be cured:
likewise the steam or spirits, which at the giving of the wound
did enter into the pores of the weapon, must not be driven out
of it, (which will be done by fire; and so when it is heated by
holding over coals, you may see a moisture sweat out of the
blade at the opposite side to the fire, as farre as it entred into the
wounded persons body; which being once all sweated out, you
shall see no more the like steam upon the sword) neither must
the bloud be washed out of the bloody cloth; for in these cases,
the powder, or salve, will work nothing. Likewise, if there be
any excesse either of heat or of cold in keeping the medicated wea-
pon or cloth; the patient feeleth that, as he would do, if the like
excesse

excesse were in any remedy that were applied to the wound it self: likewise if the medicated weapon or bloody cloth, be kept too close, no effect followeth: likewise, the natures of the things used in these cures are of themselves soveraigne for healing the like griefs, though peradventure too violent if they were applied in body without much attenuation.

And truly if we will deny all effects of this kind, we must in a manner renounce all humane faith: men of all sorts and qualities (and many of them such in my own knowledge, as I cannot question their prudence in observing, or their sincerity in relating) having very frequently made experience of such medicines, and all affirming after one fashion to have found the same effects. Adde to these, the multitude of other like effects, appearing or conceited to appear in other things. In some countries it is a familiar disease with kine to have a swelling in the soles of their feet: and the ordinary cure is, to cut a turf upon which they have troden with their sore foot, and to hang it upon a hedge; and as that dryeth away, so will their sore amend. In other parts they observe, that if milk newly come from the cow, do in the boiling runne over into the fire; and that this do happen often, and near together to the same cows milk; that cow will have her udder sore and inflamed: and the prevention is to cast salt immediately into the fire upon the milk. The herb *Persicaria* if it be well rubbed upon warts, and then be laid in some fit place to putrifie, causeth the warts to wear away as it rotteth: some say the like of fresh beef. Many examples also there are of hurting living creatures by the like means; which I set not down for fear of doing more harm by the evil inclination of some persons into whose hands they may fall; then profit by their knowing them, unto whom I intend this work.

But to make these operations of nature not incredible; let us remember how we have determined that every body whatsoever doth yield some steam, or vent a kind of vapour from it self; and consider, how they must needs do so most of all, that are hot and moist, as bloud and milk are, and as all wounds and sores generally are. We see that the foot of a hare or deer leaveth such an impression where the beast hath passed, as a dog can discern it a long time after: and a fox breatheth out so strong a vapour, that the hunters themselves can wind it a great way off,

and a good while after he is parted from the place. Now joyn-
 ing this, to the experiences we have already allowed of, con-
 cerning the attraction of heat; we may conclude that if any of
 these vapours do light upon a solid warm body, which hath the
 nature of a source unto them, they will naturally congregate
 and incorporate there; and if those vapours be joyned with any
 medicative quality or body, they will apply that medicament
 better then any chirurgeon can apply it. Then, if the steam of
 bloud and spirits, do carry with it from the weapon or cloth, the
 balsamike qualities of the salve or powder, and with them do
 settle upon the wound; what can follow but a bettering in it?
 Likewise, if the steam of the corruption that is upon the clod, do
 carry the drying quality of the wind which sweepeth over it
 when it hangeth high in the aire, unto the sore part of the cows
 foot; why is it not possible that it should dry the corruption
 there, as well as it dryeth it upon the hedge? And if the steam
 of burned milk can hurt by carrying fire to the dugge; why
 should not salt cast upon it, be a preservative against it? Or ra-
 ther, why should not salt hinder the fire from being carried thi-
 ther? Since the nature of salt, alwayes hindereth and suppres-
 seth the activity of fire: as we see by experience when we throw
 salt into the fire below, to hinder the flaming of soot in the top
 of a chimney: which presently ceaseth, when new fire from
 beneath doth not continue it. And thus we might proceed in
 sundry other effects, to declare the reason and the possibility of
 them; were we certain of the truth of them: therefore we remit
 this whole question, to the authority of the testimonies.

CHAP. XIX.

*Of three other motions belonging to particular bodies, Filtra-
 tion, Restitution, and Electricall attraction.*

I.
 What is Filtra-
 tion; and how it
 is effected.

AFTER these, let us cast our eye upon another motion, very fa-
 miliar among Alchymists; which they call Filtration. It is
 effected by putting one end of a tongue, or labell of flannen,
 or of cotton, or of flax, into a vessel of water, and letting
 the other end hang over the brim of it. And it will by little and
 little draw all the water out of that vessel (so that the end which
 hangeth out be lower then the superficies of the water) and will
 make it all come over into any lower vessel you will reserve it
 in

The end of this operation is, when any water is mingled with grosse and muddy parts (not dissolved in the water) to separate the pure and light ones from the impure. By which we are taught that the lighter parts of the water, are those which most easily do catch. And if we will examine in particular, how it is likely this businessse passeth; we may conceive that the body or linguet by which the water ascendeth, being a dry one, some lighter parts of the water, whose chance it is to be near the climbing body of flaxe, do begin to stick fast unto it: and then, they require nothing near so great force, nor so much pressing, to make them climbe up along the flaxe, as they would do to make them mount in the pure aire. As you may see, if you hold a stick in running water, shelving against the stream: the water will run up along the stick, much higher then it could be forced up in the open aire without any support, though the agent were much stronger then the current of the stream. And a ball will upon a rebound, run much higher upon a shelving board, then it would if nothing touched it. And I have been told that if an eggshell filled with dew be set at the foot of a hollow stick, the sun will draw it to the top of the shelving stick, whereas without a prop, it will not stirre it.

With much more reason then, we may conceive that water finding as it were little steps in the cotton to facilitate its journey upwards, must ascend more easily then those other things do; so as it once receive any impulse to drive it upwards: for the gravity both of that water which is upon the cotton, as also, of so many of the confining parts of water as can reach the cotton; is exceedingly allayed, either by sticking unto the cotton, and so weighing in one bulk with that dry body; or else, by not tending down straight to the center, but resting as it were upon a steep plain (according to what we said of the arme of a syphon that hangeth very sloping out of the water, and therefore draweth not after it a lesse proportion of water in the other arme that is more in a direct line to the center :) by which means the water as soon as it beginneth to climbe, cometh to stand in a kind of cone; neither breaking from the water below, (its bulk being big enough to reach unto it) nor yet falling down unto it.

But our chief labour must be, to find a cause that may make the water begin to ascend. To which purpose, consider how water

2.
What causeth
the water in Al-
tation to asc-
cend.

of:

of its own nature, compresseth it self together, to exclude any other body lighter then it is. Now in respect of the whole masse of the water, those parts which stick to the cotton, are to be accounted much lighter then water; not, because in their own nature they are so; but for the circumstances which accompany them, and do give them a greater disposition to receive a motion upwards then much lighter bodies, whiles they are destitute of such helps. Wherefore as the bulk of water weighing and striving downwards; it followeth that if there were any air mingled with it, it would to possesse a lesser place, drive out the aire: so here in this case, the water that is at the foot of the ladder of cotton, ready to climbe with a very small impulse, may be after some sort compared (in respect of the water) to aire by reason of the lightnesse of it: and consequently is forced up by the compressing of the rest of the water round about it. Which no faster getteth up, but other parts at the foot of the ladder do follow the first, and drive them still upwards along the tow; and new ones drive the second, and others the third, and so forth. So that with ease they climbe up to the top of the filter, still driving one another forwards, as you may do a fine towell through a musket barrell: which though it be too limber to be thrust straight through; yet cramming still new parts into it at the length you will drive the first quite through.

And thus, when these parts of water are got up to the top of the vessell on which the filter hangeth, and over it on the other side by sticking still to the tow, and by their naturall gravity, against which nothing presseth on this side the labell; they fall down again by little and little, and by drops break again into water in the vessell set to receive them.

But now if you ask, why it will not drop unlesse the end of the labell that hangeth, be lower then the water. I conceive it is because the water which is all along upon the flannen, is one continued body hanging together, as it were a thrid of wire; and is subject to like accidents as such a continued body is. Now suppose you lay a wire upon the edge of the basin, which the filter resteth upon; and so make that edge the center to ballance it upon; if the end that is outermost be heaviest, it will veigh down the other; othervise, not. So fareth it vwith this thrid of vwater: if the end of it that hangeth out of the pot, that is to be filtered

3.
Why the filter will not drop unlesse the labell hang lower then the water.

filtered be longer, and consequently heavier, then that which riseth; it must needs raise the other upwards, and fall it self downwards. Now the raising of the other, implieth lifting more water from the cistern, and the sliding of it self further downwards, is the cause of its converting into drops. So that the water in the cistern serveth like the flax upon a distaffe, and is spun into a thrid of water, still as it cometh to the flannen by the drawing it up, occasioned by the overweight of the thrid on the other side of the center.

Which to expresse better by a similitude in a solide body: I remember I have oftentimes seen in a Mercers shop, a great heap of massy gold lace lie upon their stall; and a little way above it a round smooth pin of wood, over which they use to hale their lace when they wind it into bottomes. Now over this pin, I have put one end of the lace; and as long as it hung no lower then the board upon which the rest of the lace did lie, it stirred not; for as the weight of the loose end carried it one way, so the weight of the other side where the whole was, drew it the other way, and in this manner kept it in equilibrium. But as soon as I drew on the hanging end to be heavier then the climbing side (for no more weigheth then is in the aire, that which lieth upon the board, having another center) then it began to roule to the ground; and still drew up new parts of that which lay upon the board, untill all was tumbled down upon the floore. In the same mander it hapneth to the water; in which, the thrid of it upon the filter is to be compared fitly unto that part of the lace which hung upon the pin; and the whole quantity in the cistern, is like the bulk of lace upon the shopboard; for as fast as the filter draweth it up, it is converted into a thrid like that which is already upon the filter: in like manner as the wheel converteth the flax into yarn, as fast as it draweth it out from the distaffe.

Our next consideration will very aptly fall upon the motion of those things, which being bent, do leap with violence to their former figure: whereas others return but a little; and others do stand in that ply, wherein the bending of them hath set them. For finding the reason of which effects, our first reflexion may be to note, that a superficies which is more long then broad, containeth a lesse floore then that whose sides are equall, or nearer being equal: and that of those surfaces whose lines and angles are

4.

Of the motion
of Restitution:
and why some
bodies stand
bent, others not

all equal, that which hath most sides and angles, containeth still the greater floore. Whence it is that Mathematicians conclude a circle to be the most capacious of all figures: and what they say of lines in respect of a superficies; the same with proportion they say of surfaces in respect of the body contained. And accordingly we see by consequence, that in the making a bag of a long napkin, if the napkin be sewed together longwise, it holdeth a great deal lesse then if it be sewed together broadwise.

By this we see plainly, that if any body which is in a thick and short figure, be forced into a thinner (which by becoming thinner, must likewise become either longer or broader; for what it loseth one way it must get another) then that superficies must needs be stretched; which in our case, is a Physicall outside, or materiall part of a solid body, not a Mathematicall consideration of an indivisible Entity. We see also that this change of figures happeneth in the bending of all those bodies, whereof we are now enquiring the reason why some of them restore themselves to their originall figures, and others stand as they are bent.

Then to begin with the latter sort, we find that they are of a moist nature; as among metalls, lead, and tinne; and among other bodies, those which we account soft. And we may determine that this effect proceedeth, partly from the humidity of the body that standeth bent; and partly from a driness peculiar to it that comprehendeth and fixeth the humidity of it. For by the first, they are rendered capable of being driven into any figure, which nature or art desireth: and by the second, they are preserved from having their gravity put them out of what figure they have once received.

But because these two conditions are common to all solid bodies, we may conclude, that if no other circumstance concurred the effect arising out of them would likewise be common to all such: and therefore, where we find it otherwise, we must seek further for a cause of that transgression. As for example, if you bend the bodies of young trees, or the branches of others, they will return to their due figure. It is true, they will sometimes lean towards that way they have been bent: as may be seen even in great trees after violent tempests; and generally the heads of trees, and the ears of corn, and the grown hedgerowes will all bend one way in some countries, where some one wind hath a main

main predominance and reigneth most continually, as near the seashore upon the western coast of England (where the southwest wind bloweth constantly the greatest part of the yeare) may be observed: but this effect proceeding from a particular and extraordinary cause, concerneth not our matter in hand.

We are to examine the reason of the motion of Restitution, which we generally see in young trees, and branches of others, as we said before. In such, we see that the earthy part which maketh them stiffe (or rather stark) aboundeth more in them than in the others that stand as they are bent: at the least in proportion to their natures; but I conceive this is not the cause of the effect we enquire about; but that it is a subtile spirit which hath a great proportion of fire in it. For as in rarefaction, we found that fire, which was either within or without the body to be rarified, did cause the rarefaction, either by entering into it, or by working within it: so seeing here the question is, for a body to go out of a lesser superficies into a greater (which is the progresse of rarefaction; and hapneth in the motion of restitution;) the work must needs be done by the force of heat. And because this effect proceedeth evidently, out of the nature of the thing in which it is wrought, and not from any outward cause, we may conclude it hath its origine from a heat that is within the thing it self, or else that was in it, and may be pressed to the outward parts of it, and would sink into it again.

As for example, when a young tree is bended; both every mans conceit is; and the nature of the thing maketh us believe, that the force which bringeth the tree back again to its figure, cometh from the inner side that is bent; which is compressed together, as being shrunk into a circular figure from a straight one: for when solide bodies that were plain on both sides, are bent so as on each side to make a portion of a circle, the convex superficies will be longer then it was before, when it was plain, but the concave will be shorter. And therefore we may conceive that the spirits which are in the contracted part, (being there squeezed into lesse room, then their nature well brooketh) do work themselves into a greater space; or else that the spirits which are crushed out of the convex side by the extension of it, but do remain besieging it, and do strive to get in again, (in such manner as we have declared when we spoke of attraction, wherein we shewed

how the emitted spirits of any body will move to their own source, and settle again in it, if they be within a convenient compass;) and accordingly do bring back the extended parts to their former situation; or rather, that both these causes do in their kinds concur to drive the tree into its naturall figure.

5. Why some bodies return onely in part to their naturall figure; others entirely.

But as we see when a stick is broken, it is very hard to replace all the splinters, every one in its proper situation; so it must of necessity fall out in this bending, that certain insensible parts both inward and outward are thereby displaced, and can hardly be perfectly rejoynted. Whence it followeth that as you see the splinters of a half broken stick, meeting with one another do hold the stick somewhat crooked; so these invisible parts do the like in such bodies as after bending stand a little that way. But because they are very little ones, the tree or the branch that hath been never so much bended, may (so nothing be broken in it) be set straight again by pains, without any notable detriment of its strength. And thus you see the reason of some bodies returning in part to their naturall figure, after the force leaveth them that did bend them.

Out of which you may proceed to those bodies that restore themselves entirely: whereof steel is the most eminent. And of it, we know that there is a fiery spirit in it, which may be extracted out of it, not onely by the long operations of calcining; digesting and distilling it; but even by grosse heating it, and then extinguishing it in wine and other convenient liquors; as Physicians use to do. Which is also confirmed by the burning of steeldust in the flame of a candle, before it hath been thus wrought upon, which afterwards it will not do: whereby we are taught that originally there are store of spirits in steel, till they are sucked out. Being then assured, that in steel there is such abundance of spirits; and knowing that it is the nature of spirits to give a quick motion; and seeing that duller spirits in trees do make this motion of Restitution; we need seek no further, what it is that doth it in steel, or in any other things that have the like nature: which through the multitude of spirits that abound in them (especially steel) do return back with so strong a jerk, that their whole body will treble a great while after, by the force of its own motion.

6. Concerning the nature of

By what is said, the nature of those bodies which do shrink and stretch, may easily be understood: for they are generally composed

posed of stringy parts, unto which, if humidity happen to arrive, they grow thereby thicker and shorter. As we see that drops of water getting into a new rope of a well, or into a new cable, will swell it much thicker, and by consequence make it shorter. Galileus noteth such wetting to be of so great efficacy, that it will shrink a new cable, and shorten it notably; notwithstanding the violence of a tempest, and the weight and jerks of a laden ship, do strain it what is possible for them to stretch it. Of this nature leather seemeth to be, and parchment, and divers other things, which if they be proportionably moistened, (and no exterior force be applyed to extend them) will shrink up; but if they be overwetted, they will become flaccide. Again, if they be suddenly dried, they will shrivell up; but if they be fairly dried after moderate wetting, they will extend themselves again to their first length.

The way having been opened by what we have discoursed before we came to the motion of Restitution, towards the discovery of the manner how heavy bodies may be forced upwards contrary to their naturall motion, by very small means in outward appearance; let us now examine (upon the same grounds) if like motions to this of water, may not be done in some other bodies in a subtiler manner. In which, more or lesse needeth not trouble us; since we know, that neither quantity nor the operations of it do consist in an indivisible, or are limited to determined periods they may not passe. It is enough for us to find a ground for the possibility of the operation: and then the perfecting of it and the reducing of it to such a height as at the first might seem impossible and incredible, we may leave to the oeconomy of wise nature. He that learneth to reade, write, or to play on the lute, is in the beginning ready to lose heart at every step; when he considereth with what labour, difficulty, and slownesse he joyneth the letters, spelleth syllables, formeth characters, fitteth and breaketh his fingers (as though they were upon the rack) to stop the right frets, and to touch the right strings. And yet you see how strange a dexterity is gained in all these by industry and practise; and a readinesse beyond what we could imagine possible, if we saw not daily the effects.

If then vve can but arrive to decipher the first characters of the hidden alphabet vve are now taking in hand, & can but spellingly

these bodies
which do shrink
and stretch.

7.

How great and
wonderfull ef-
fects proceed
from small,
plain, and sim-
ple principles.

lingly read the first syllables of it; we need not doubt, but that the wise Author of nature in the masterpiece of the creature (which was to expresse the excellency of the workman) would with excellent cunning and art dispose all circumstances so aptly, as to speak readily a complete language arising from those Elements; and that should have as large an extent in practise and expression, beyond those first principles; which we like children only lisp out; as the vast discourses of wisest and most learned men are beyond the spellings of infants: and yet those discourses spring from the same root, as the others spellings do, and are but a raising of them to a greater height; as the admired musick of the best player of a lute or harp, that ever was, is derived from the harsh twangs of course bowstrings, which are composed together and refined, till at length they arrive to that wonderfull perfection. And so without scruple, we may in the business we are next falling upon, conclude that the admirable and almost miraculous effects we see, are but the elevating to a wonderfull height those very actions and motions which we shall produce as causes and principles of them.

8.

Concerning
Electrical at-
traction, and
the causes of it.

Let us then suppose, that there is a solid hard body, of an unctuous nature; whose parts are so subtil and fiery, that with a little agitation they are much rarified, and do breath out in steams, (though they be too subtil for our eyes to discern) like unto the steam that issueth from sweating men or horses, or like the steam that flyeth from a candle when it is put out: but that these steams, as soon as they come into the cold aire, are by that cold suddenly condensed again; and by being condensed, do shorten themselves, and by little and little do retire, till they settle themselves upon the body from whence they sprung: in such manner as you may observe, the little tender horns of snails use to shrink back if any thing touch them, till they settle in little lumps upon their heads. If I say these strings of bituminous vapour should in their way outwards meet with any light & spongie body, they would pierce into it and settle in it; and if it were of a competent bignesse for them to wield, they would carry it with them which way soever they go; so that if they shrink back again to the fountain from whence they came, they must needs carry back with them the light spongie body they have fixed their darts in.

Consider then, that how much heat rarifieth, so much cold condenseth:

condenseth: and therefore such parts as by agitation were spun out into a subtile thricke of an inch long for example, as they cool, do grow bigger and bigger, and consequently shorter and shorter, till at length, they gather themselves back into their main body; and there they settle again in cold bitumen as they were at the first; and the light body that they stick unto, is drawn back with them, and consequently sticketh to the superficies of the bitumen. As if something were tyed at one end of a lutestring extended to its utmost capacity, and the other end were fastened to some pinne; as the string shrinketh up, so that which is tyed at it, must needs move nearer and nearer the pin: which artifice of nature jugglers do imitate, when by means of an unseen hair, they draw light bodies to them. Now if all this operation be done, without your seeing the little thrids w^{ch} cause it; the matter appears wonderfull & strange. But when you consider this progresse that we have set down, you will judge it possible

And this seemeth to be the case of those bodies which we call Electricall; as yellow amber, jet, and the like. All which, are of a bituminous unctuous nature, as appeareth by their easie combustibility & smell, when they are burned. And if some do not so apparently shew this unctuous nature, it is because either they are too hard, or else they have a high degree of aqueous humidity joynd with their unctuousity: and in them the operation will be duller in that proportion; for as we see that unctuous substances are more odoriferous then others, & do send their steams further off, and more efficaciously; so we cannot doubt but that such bodies as consist in a moist nature do accordingly send forth their emanations in a feebler proportion. Yet that proportion will not be so feeble, but that they may have an Electricall effect, as well as the more efficacious Electricall bodies, w^{ch} may be perceptible, if exact experience be made by an instrument like the mariners needle; as our learned countryman D^r Gilbert teacheth

But that in those eminent agents, the spirits, whereby they attract, are unctuous, is plain, because the fire consumeth them; and so if the agents be overheated they cannot work; but moderate heat even of fire increaseth their operation. Again, they are clogged by misty aire, or by wetting: and likewise, are pierced through and cut asunder by spirit of wine or aqua ardentis; but oyl doth not hurt them. Likewise, they yield more spirits in

the sunne then in the shade; and they continue longer, when the aire is cleared by North or by Eastern winds. They require to be polished; either because the rubbing which polisheth them, doth take off from their surfaces the former emanations, which returning back do stick upon them, and so do hinder the passage of those that are within; or else, because their outsides may be foul; or lastly, because the pores may be dilated by that smoothing. Now that hardnesse and solidity is required, doth argue that these spirits must be quick ones, that they may return smartly, and not be lost through their languishing in the aire. Likewise, that all bodies which are not either exceeding rare, or else set on fire, may be drawn by these unctuous thrids; concludeth that the quality by which they do it, is a common one that hath no particular contrarieties; such a one as we see is in grease or in pitch to stick to any thing; from which in like manner nothing is exempted but fire and aire. And lastly, that they work most efficaciously, when they are heated by rubbing, rather than by fire; sheweth that their spirits are excited by motion, and are thereby made to flie abroad; in such manner as we see in pomanders, and in other perfumes, which must be heated if you will have them communicate their sent:& alike effect as in them, agitation doth in jet, yellow amber, & such other Electricall bodies; for if upon rubbing them, you put them presently to your nose, you will discern a strong bituminous smell in them; all which circumstances do shew that this electricall virtue, consists in a certain degree of rarity or density of the bodies unctuous emanations

Now if these refined and viscuous thrids of jet or amber, do in their streaming abroad meet with a piece of straw, or of hay, or of a dried leaf, or some such light and spongie body; it is no marvail if they glew themselves unto it like birdlime; and that in their shrinking back (by being condensed again and repulsed, through the coldnesse of the aire) they carry it along with them to their entire body. Which they that onely see the effect, and cannot penetrate into a possibility of a naturall cause thereof, are much troubled withall.

9.
Cabeus, his opinion refused concerning the cause of Electricall motions.

And this seemeth unto me to bear a fairer semblance of truth, then what Cabeus delivereth for the cause of Electricall attractions. Whose speculation herein, though I cannot allow for solid; yet I must for ingenious. And certainly even errors are to be commended,

commended, when they are witty ones, and do proceed from a casting further about then the beaten track of verball learning, or rather terms which explicate not the nature of the thing in question. He saith that the coming of straws and such other light bodies unto amber, jet, and the like, proceedeth from a wind raised by the forcible breaking out of subtile emanations from the Electricall bodies into the aire, which bringeth those light bodies along with it to the Electricall ones.

But this discourse cannot hold: for first, it is not the nature of unctuous emanations (generally speaking) to cause smart motions singly of themselves. Secondly, although they should raise a wind, I do not comprehend how this wind should drive bodies directly back to the source that raised it; but rather any other way; and so consequently, should drive the light bodies it meeteth with in its way, rather from, then towards the Electricall body. Thirdly, if there should be such a wind raised, & it should bring light bodies to the Electricall ones; yet it could not make them stick thereunto, which we see they do, turn them which way you will, as though they were glewed together.

Neither do his experiences convince any thing; for what he saith that the light bodies are sometimes brought to the Electricall body with such a violence, that they rebound back from it, and then return again to it, maketh rather against him: for if wind were the cause of their motion, they would not return again, after they had leaped back from the Electricall body; no more then we can imagine that the wind it self doth.

The like is of his other experience, when he observed that some little grains of saw-dust hanging at an Electricall body, the furthermost of them not onely fell off, but seemed to be driven away forcibly: for they did not fall directly down, but sideways; and besides did flie away with a violence and smartnesse that argued some strong impulse. The reason whereof might be, that new emanations might smite them, which not sticking and fastening upon them, whereby to draw them nearer, must needs push them further: or it might be that the emanations unto which they were glewed, shrinking back unto their main body, the latter grains were shouldered off by others that already besieged the superficies; and then the emanations retiring swiftly the grains must break off with a force: or els we may conceive it was the force

of the aire that bore them up a little, which made an appearance of their being driven away; as we see feathers and other light things descend not straight down.

CHAP. XX.

Of the Loadstones generation; and its particular motions.

I.
The extreme heat of the sunne under the zodiack, draweth a stream of aire from each pole into the torrid zone.

Here is yet remaining, the great mystery of the Loadstone to discourse of. Which all Authors, both ancient and modern, have agreed upon as an undeniable example and evidence of the shortnesse of mans reach in comprehending, and of the impossibilitie of his reason in penetrating into, and explicating such secrets, as nature hath a mind to hide from us. Wherefore our reader (I am sure) will not in this subject expect clear satisfaction or plain demonstrations, at our hands; but will judge we have fairly acquitted our selves, if what we say be any whit plausible.

Therefore, to use our best indeavours to content him; let us reflect upon the disposition of parts of this habitable globe, whereof we are tenants for lives. And we shall find that the sun by his constant course under the zodiack, heateth a great part of it unmeasurably more then he doth the rest. And consequently, that this zodiack being in the midst between two (as it were) ends, which we call the Poles, these poles must necessarily be extremely cold, in respect of the torrid zone; for so we call that part of the earth which lieth under the zodiack.

Now looking into the consequence of this; we find that the sunne, or the sunnes heat which reflecteth from the earth in the torrid zone, must rarifie the aire extremely, and according to the nature of all heat and fire, must needs carry away from thence, many parts of the aire and of the earth sticking to that heat, in such sort as we have formerly declared.

Whence it followeth, that other aire must necessarily come from the regions towards both the poles, to supply what is carried away from the middle, as is the course in other fires, and as we have explicated above: especially considering, that the aire which cometh from the polewards, is heavier then the aire of the torride zone; and therefore, must naturally presse to be still nearer the earth; and so, as it were shouldereth up the aire

of the torrid zone towards the circumference, by rolling into its place : and this, in great quantities ; and consequently, the polar aire must draw a great train after it.

Which if we consider the great extent of the torrid zone, we shall easily perswade our selves, that it must reach on each side, to the very pole : for taking from Archimedes, that the spheri- call superficies of a portion of a sphere, is to the superficies of the whole sphere, according as the parts of the axis of that sphere comprised within the said portion, is to the whole axis : and considering that (in our case) the part of the axis comprised within the torrid zone, is to the whole axis of the earth, in about the proportion of 4. to. 10; it must of necessity follow that a fire or great heat reigning in so vast an extent, will draw aire very powerfully from the rest of the world.

Neither let any man apprehend that this course of the sunnes elevating so great quantities of atomes in the torrid zone, should hinder the course of gravity there : for first the medium is much rarer in the torrid zone then in other parts of the earth; & therefore the force of the descending atomes needeth not to be so great there as in other places, to make bodies descend there as fast as they do elsewhere. Secondly, there being a perpetu- all supply of fresh aire from the polar parts, streaming continu- ally into the torrid zone; it must of necessity happen that in the aire there come atomes to the torrid zone, of that grossnesse that they cannot suddenly be so much rarified as the subtiler parts of aire that are there : and therefore, the more those sub- tiler parts are rarified, and thereby happen to be carried up, the stronger and the thicker the heavier atomes must descend. And thus this concourse of aire from the polar parts, maintaineth gravity under the zodiack ; where otherwise all would be turn- ed into fire, and so have no gravity.

Now, who considereth the two hemispheres which by the equator are divided ; will find that they are not altogether of equall complexions ; but that our hemisphere, in which the Northpole is comprised, is much dryer then the other, by rea- son of the greater continent of land in this, and the vaster tract of sea in the other; and therefore the supply which cometh from the divers hemispheres, must needs be of different natures ; that which cometh from towards the Southpole, being compared to

2.

The atomes of these two streams coming together are apt to incorpo- race with one another.

that:

that which cometh from towards the North, as the more wet to the more dry. Yet of how different complexions soever they be, you see they are the emanations of one and the same body. Not unlike unto what nature hath instituted in the rank of animals: among whom, the male & the female are so distinguished by heat and cold, moisture and drought; that neverthelesse all belongeth but to one nature; and that, in degrees though manifestly different, yet so near together that the body of one is in a manner the same thing, as the body of the other. Even so, the complexions of the two hemispheres are in such sort different in the same qualities, that neverthelesse they are of the same nature, and are unequal parts of the same body which we call the earth. Now Alchimists assure us, that if two extractions of one body do meet together they will incorporate one with the other; especially, if there be some little difference in the complexion of the extractions.

3.
By the meeting
and mingling
together of
these streams at
the Equator,
divers rivulets
of atomes of
each Pole, are
continued
from one Pole
to the other.

Whence it followeth that these two streams of aire, making up one continueate fload of various currents, from one end of the world to the other; each stream that cometh to the equator from its own Pole, by the extraction of the sunne, and that is still supplied with new matter flowing from its own pole to the equator, before 'the sunne can sufficiently rarifie and lift up the atomes that came first perpendicularly under its beams (as it useth to happen in the effects of Physicall causes, which cannot be rigourously ajusted, but must have some latitude; in which, nature inclineth ever rather to abundance then to defect,) will passe, even to the other pole, by the conduct of his fellow, in case he be by some occasion driven back homewards.

For as we see in a boule or pail full of water, or rather in a pipe, through which the water runneth along; if there be a little hole at the bottome or side of it, the water will wriggle and change its course to creep out at that pipe; especially if there be a little spiggot, or quill at the outside of the hole, that by the narrow length of it helpeth in some sort (as it were) to suck it. So if any of the files of the army or fload of atomes sucked from one of the Poles to the equator, do there find any gappes; or chinks, or lanes of retiring files in the front of the other poles battalia of atomes, they will presse in there: in such manner as we have above declared that water doth by the help of a labell

of cotton; and as is exemplified in all the attractions of venime by venomous bodies whereof we have given many examples above: and they will go along with them the course they go. For as when a thick short gilded ingot of silver is drawn out into a long subtil wyre; the wyre continuing still perfectly gilded all over, doth manifestly shew that the outside and the inside of the ingot, do strangely meet together, and intermix in the drawing out: so this little stream which (like an eddy current) runneth back from the equator towards its own Pole, will continue to the end still tinged with the mixture of the other Poles atomes, it was incorporated with at his coming to the equator.

Now that some little rivolets of aire and atomes should runne back to their own Pole, contrary to the course of their main stream will be easily enough to conceive; if we but consider that at certain times of the year winds do blow more violently and strongly from some determinate part or Rombe of the world, then they do at other times and from other parts. As for example; our East India Mariners tell us of the famous Monsoones they find in those parts; which are strong winds that reign constantly six moneths of the year from one polewards, and the other six moneths, from the other pole, & begin precisely about the suns entering into such a signe or degree of the zodiack, and continue till about its entrance into the opposite degree. And in our parts of the world certain smart Easterly or Northeasterly winds do reigne about the end of March & beginning of April; when it seemeth that some snows are melted by the spring heats of the sun. And other winds have their courses in other seasons, upon other causes. All which do evidently convince, that the course of the aire, and of vapours from the poles to the equator, cannot be so regular & uniform, but that many impediments & crosses do light in the way, to make breaches in it; & thereby to force in it some places to an opposite course. In such sort as we see happeneth in eddy waters, & in the course of a tide, wherein the stream running swiftly in the middle, beateth the edges of the water to the shore, & thereby maketh it run back at the shore. And hence we may conclude, that although the main course of aire & atomes (for example from north to south, in our hemisphere) can never fail of going on towards the equator, constantly at the

same rate, in grosse; nevertheless, in severall particular little parts of it (& especially at the edges of those streams that are driven on faster then the rest, by an extraordinary and accidentall violent cause) it is variously interrupted, and sometimes entirely stopped, and other times even driven back to the northwards.

And if peradventure any man should think that this will not fall out, because each stream seemeth to be alwayes coming from his own Pole to the equator, and therefore will oppose and drive back any bodies that with lesse force should strive to swim against it; or if they stick unto them, will carry them back to the equator. We answer, that we must not conceive that the whole aire in body doth every where equally incroch from the polewards upon the torrid zone; but, as it were, in certain brooks or rivolets, according as the contingency of all causes put together doth make it fall out.

Now then out of what we have said it will follow; that since all the aire in this our hemisphere is as it were strewed over and sowed with abundance of northern atomes, & that some brooks of them are in station, others in a motion of retrogradation back to their own north pole; the southern atomes (which coming upon them at the equator do not onely presse in among them, wheresoever they can find admittance, but do also go on forwards to the north pole in severall files by themselves, being driven that way by the same accidentall causes, which make the others retire back) seizing in their way upon the northern ones in such manner as we described in filtration; and thereby creeping along by them wheresoever they find them standing still, and going along with them wheresoever they find them going back; must of necessity find passage in great quantities towards, and even to the north pole; though some parts of them will ever & anon be checked in this their journey by the main current prevailing over some accidentall one, and so be carried back again to the equator, whose line they had crossed.

And this effect cannot choosé but be more or lesse according to the seasons of the year: for when the sun is in the Tropick of Capricorn, the southern atomes will flow in much more abundance, and with farre greater speed, into the torrid zone, then the northern atomes can; by reason of the suns approximation to the south, and his distance from the north pole; since he
work-

worketh faintest, where he is furthest off: and therefore from the north no more emanations or atomes will be drawn, but such as are most subtilised, and duly prepared for that course. And since onely these selected bands do now march towards the equator, their files must needs be thinner, then when the sunnes being in the equator or Tropick of Cancer wakeneth and mustereth up all their forces. And consequently, the quiet parts of aire between their files (in which like atomes are also scattered) are the greater: whereby the advenient southern atomes have the larger filter to climbe up by. And the like happeneth in the other hemisphere, when the sunne is in the Tropick of Cancer; as who will bestow the pains to compare them, will presently see.

Now then let us consider what these two streams thus incorporated must of necessity do in the surface or upper parts of the earth. First, it is evident they must needs penetrate a pretty depth into the earth; for so freeing perswadeth us, and much more, the subtile penetration of divers more spirituall bodies, of which we have sufficiently discoursed above. Now let us conceive that these steams do find a body of a convenient density to incorporate themselves in, in the way of density, as we see that fire doth in iron, and in other dense bodies: and this not for an hour or two as happeneth in fire; but for years: as I have been told that in the extreme cold hills in the Peak in Darbyshire happeneth to the dry atomes of cold, which are permanently incorporated in water by long continuall freeing and so make a kind of chrysell.

In this case, certainly it must come to passe that this body will become in a manner wholly of the nature of these steams: which because they are drawn from the Poles that abound in cold and drynesse, (for others that have not these qualities, do not contribute to the intended effect) the body is aptest to become a stone: for so we see that cold & drought turneth the superficial parts of the earth into stones & rocks; & accordingly, wheresoever cold & dry winds reigne powerfully, all such countries are mainly rocky

Now then let us suppose, this stone to be taken out of the earth and hanged in the aire, or set conveniently upon some little pin, or otherwise put in liberty, so as a small impulse may easily turn it any way: it will in this case certainly follow, that the

4.
Of these atomes incorporated with some fit matter in the bowels of the earth, is made a stone.

5.
This stone worke:h by emanations, joyned with agreeing steams: that meet them in the aire; and in fire it is a lead-stone.

end

end of the stone which in the earth lay towards the north pole, will now in the aire convert it self in the same manner towards the same point; and the other end which lay towards the south, turn by consequence to the south. I speak of these countries which lie between the equator and the north; in which it cannot chuse but that the stream going from the north to the equator, must be stronger then the opposite one.

Now to explicate, how this is done; suppose the stone hanged east and west freely in the aire; the stream which is drawn from the north pole of the earth rangeth along by it in its course to the equator; and finding in the stone the south steam, (which is grown innate to it) very strong, it must needs incorporate it self with it; and most, by those parts of the steam in the stone which are strongest: which are they that come directly from the North of the stone; by which I mean that part of the stone that lay northward in the earth, and that still looketh to the north pole of the earth now it is in the aire. And therefore the great flood of atomes coming from the north pole of the earth will incorporate it self most strongly, by the north end of the stone with the little flood of southern atomes it findeth in the stone: for that end serveth for the coming out of the southern atomes; and sendeth them abroad; as the south end doth the northern steam, since the steams do come in at one end; and do go out at the opposite end.

From hence we may gather, that this stone will joyn and cleave to its attractive, whensoever it happeneth to be within the sphere of its activity. Besides, if by some accident it should happen that the atomes or steams which are drawn by the sunne from the Polewards to the equator, should come stronger from some part of the earth, which is on the side hand of the Pole, then from the very Pole it self; in this case the stone will turn from the Pole towards that side. Lastly, whatsoever this stone will do towards the Pole of the earth; the very same a lesser stone of the same kind will do towards a greater. And if there be any kind of other substance that hath participation of the nature of this stone, such a substance will behave it self towards this stone, in the same manner, as such a stone behaveth it self towards the earth: all the Phenomens whereof may be the more plainly observed, if the stone be cut into the form of the earth.

And

And thus, we have found a perfect delineation of the loadstone from its causes: for there is no man so ignorant of the nature of a loadstone, but he knoweth that the properties of it are to tend towards the North; to vary sometimes; to joyn with another loadstone; to draw iron unto it; and such like, whose causes you see delivered.

But to come to experimentall proofs and observations upon the loadstone by which it will appear, that these causes are well esteemed and applyed, we must be beholding to that admirable searcher of the nature of the loadstone Doctour Gilbert; by means of whom and of Doctour Harvey, our Nation may claim even in this latter age as deserved a crown for solid Philosophicall learning, as for many ages together it hath done formerly for acute and subtile speculations in Divinity. But before I fall to particulars, I think it worth warning my Reader, how this great man arrived to discover so much of Magneticall Philosophy; that he likewise, if he be desirous to search into nature, may by imitation advance his thoughts & knowledge that way.

In short then, all the knowledge he got of this subject, was by forming a little loadstone into the shape of the earth. By which means he compassed a wonderfull designe, which was, to make the whole globe of the earth maniable: for he found the properties of the whole earth, in that little body; which he therefore called a Terrella, or little earth; and which he could manage and try experiences upon, at his will. And in like manner, any man that hath an aim to advance much in naturall sciences, must endeavour to draw the matter he enquireth of, into some small modell, or into some kinde of manageable method; which he may turn and wind as he pleaseth. And then let him be sure, if he hath a competent understanding, that he will not misse of his mark.

But to our intent; the first thing we are to prove is, that the loadstone is generated in such sort as we have described: for proof whereof, the first ground we will lay shall be to consider how in divers other effects it is manifest, that the differences of being exposed to the north or to the south, do cause very great variety in the same thing: as hereafter, we shall have occasion to touch, in the barks and grains of trees, and the like. Next, we find by experience, that this virtue of the loadstone is received

6.

A methode for making experiences upon any subject.

7.

The loadstones generation by a comes flowing from both Pole, is confirmed by experiments observed in the stone itself.

P

into

into other bodies that resemble its nature, by heatings and coolings: for so it passeth in iron barres, which being thoroughly heated, and then laid to cool north and south, are thereby imbued with a Magnetick virtue; heat opening their bodies, and disposing them to suck in, such atomes as are convenient to their nature, that flow unto them whiles they are cooling. So that we cannot doubt, but that convenient matter fermenting in its warm bed under the earth, becometh a load-stone by the like sucking in of affluent streams of a like complexion to the former.

And it fareth in like manner with those fiery instruments (as fireforks, tongues, shovels, and the like) which do stand constantly upwards and downwards; for they, by being often heated and cooled again, do gain a very strong verticity, or turning to the Pole: and indeed, they cannot stand upwards and downwards so little a while, but that they will in that short space gain a manifest verticity; and change it at every turning. Now since the force and vigour of this verticity, is in the end that standeth downwards; it is evident that this effect proceedeth out of an influence received from the earth.

And because in a load-stone (made into a globe, or considered so, to the end you may reckon hemispheres in it, as in the great earth) either hemisphere giveth unto a needle touched upon it, not onely the virtue of that hemisphere where it is touched, but likewise the virtue of the contrary hemisphere; we may boldly conclude, that the virtue which a load-stone is impregnated with in the wombe or bed of the earth, where it is formed and groweth, proceedeth as well from the contrary hemisphere of the earth, as from that wherein it lyeth; in such sort, as we have above described. And as we feel oftentimes in our own bodies, that some cold we catch remaineth in us a long while after the taking it, and that sometimes it seemeth even to change the nature of some part of our body into which it is chiefly entered, and hath taken particular possession of; so that whensoever new atomes of the like nature, do again range about in the circumstant aire, that part so deeply affected with the former ones of kinne to these, doth in a particular manner seem to risent them, and to attract them to it, and to have its guests within it (as it were) wakened and roused up by the strokes of the advenient ones that knock at their dores. Even so (but much more strongly

strongly; by reason of the longer time and lesse hinderances) we may conceive that the two virtues or atomes proceeding from the two different hemispheres, do constitute a certain permanent and constant nature in the stone that imbibeth them: which then, we call a load-stone; and is exceeding sensible (as we shall hereafter declare) of the advenience to it of new atomes, alike in nature & complexion to those that it is impregnated with

And this virtue, consisting in a kind of softer and tenderer substance than the rest of the stone, becometh thereby subject to be consumed by fire. From whence we may gather the reason why a load-stone never recovereth its magnetick virtue, after it hath once lost it; though iron doth; for the humidity of iron is inseparable from its substance, but the humidity of a load-stone, which maketh it capable of this effect, may be quite consumed by fire; and so the stone may be left too dry, for ever being capable of imbibing any new influence from the earth, unlesse it be by a kind of new making it.

In the next place we are to prove that the load-stone doth work in that manner as we have shewed: for which end let us consider how the atomes that are drawn from each Pole and hemisphere of the earth to the equatour, making up their course by a manuduction of one another, the hindermost cannot choose but still follow on after the foremost. And as it happeneth in filtration by a cotton cloth; if some one part of the cotton, have its disposition to the ascent of the water, more perfect and ready than the other parts have; the water will assuredly ascend faster in that part, than in any of the rest: so, if the atomes do find a greater disposition for their passage, in any one part of the medium they range through, then in another, they will certainly not fail of taking that way, in greater abundance, and with more vigour and strength, than any other.

But it is evident, that when they meet with such a stone as we have described, the helps by which they advance in their journey are notably increased by the flood of atomes which they meet coming out of that stone; which being of the nature of their opposite pole, they seize greedily upon them, and thereby do pluck themselves faster on: like a ferryman that draweth on his boat the swiftest, the more vigourously he tuggeth & pulleth at the rope that lyeth thwart the river for him to hale himself

8.

Experiments to prove that the loadstone worketh by emanations meeting with agreeing streams.

over by. And therefore we cannot doubt but that this flood of atomes streaming from the pole of the earth, must needs passe through that stone with more speed and vigour then they can do any other way.

And as we see in the running of water; that if it meeteth with any lower crannies then the wide channel it streamech in; it will turn out of its straight way, to glide along there where it findeth an easier and more deelive bed to tumble in: so these atomes will infallibly deturn themselves from their direct course, to passe through such a stone as farre as their greater conveniency leadech them.

And what we have said of these atomes, which from the Poles do range through the vast sea of aire to the equator; is likewise to be applyed unto those atomes which issue out of the stone: so that we may conclude, that if they meet with any help which may convey them on with more speed and vigour, then whiles they stream directly forwards; they will likewise deturn themselves from directly forwards, to take that course. And if the stone it self be hanged so nicely, that a lesse force is able to turn it about then is requisite to turn awry out of its course the continued stream of atomes which issueth from the stone: in this case, the stone it self must needs turn towards that stream which climbing and filtrig it self along the stones stream, draweth it out of its course; in such sort as the nose of a weathercock butteth it self into the wind. Now then; it being known, that the strongest stream cometh directly from the north in the great earth, & that the southern stream of the Terrella or load-stone proportioned duely by nature to incorporate with the north stream of the earth, issueth out of the north end of the stone; it follows plainly that when a loadstone is situated at liberty, its north end must necessarily turn towards the north pole of the world.

And it will likewise follow, that whensoever such a stone meeteth with another of the same nature and kind, they must comport themselves to one another in like sort: that is, if both of them be free and equall, they must turn themselves to, or from one another; according as they are situated in respect of one another. So that if their axes be parallel, and the south pole of the one, and the north of the other do look the same way, then they will send proportionate, and agreeing streams to one another
from

from their whole bodies, that will readily mingle and incorporate with one another, without turning out of their way or seeking any shorter course or changing their respects to one another

But if the poles of the same denomination do look the same way, and the loadstones do not lie in such sort as to have their axes parallel, but that they encline to one another: then they will work themselves about, untill they grow by their opposite poles into a straight line; for the same reason as we have shew'd of a loadstones turning to the pole of the earth.

But if onely one of the loadstones be free & the other be fixed, & that they lie inclined, as in the former case; then, the free stone will work himself untill his pole be opposite to that part of the fixed stone from whence the stream w^{ch} agrees with him, issueth strongest: for that stream is to the free loadstone, as the northern stream of the earth, is to a loadstone compared unto the earth. But withall, we must take notice that in this our discourse, we abstract from other accidents; & particularly, frō the influence of the earths streams into the loadstones: w^{ch} will cause great variety in these cases, if they lie not due north & south, when they begin to work.

And as loadstones and other magnetick bodies, do thus of necessity turn to one another when they are both free; and if one of them be fastened, the other turneth to it; so likewise, if they be free to progressive motion, they must by a like necessity and for the same reason, come together and joyn themselves to one another. And if onely one of them be free, that must remove it self to the other: for the same vjrtue that maketh them turn, (which is, the strength of the steam) will likewise (in due circumstances) make them come together; by reason that the steams which climbe up one another by the way of filtration, and do thereby turn the bodies of the stones upon their centers when they are onely free to turn, must likewise draw the whole bodies of the stones entirely out of their places, & make them joyn, when such a totall motion of the body is an effect that requireth no more force, then the force of conveying vigorously the streams of both the Magnetick bodies into one another; that is, when there is no such impediment standing in the way of the Magnetick bodies motion, but that the celerity of the atomes motion, mingling with one another, is able to overcome it: for then, it must needs do so; & the magnetick body by naturall coherence unto the steam

of atomes in which it is involved, followeth the course of the steam: in such sort as the example we have heretofore upon another occasion given of an eggs-shell filled with dew; the sun-beams converting the dew into smoke, and raising up that smoke or steam, the eggs-shell is likewise raised up for company with the steam that issueth from it.

And for the same reason it is, that the loadstone draweth iron: for iron being of a nature apt to receive and harbour the steams of a loadstone; it becometh a weak loadstone, and worketh towards a loadstone, in such sort as a weaker loadstone would do: and so moveth towards a loadstone by the means we have now described. And that this conformity between iron and the loadstone is the true reason of the loadstones drawing of iron, is clear out of this, that a loadstone will take up a greater weight of pure iron, then it will of impure or drossie iron; or of iron and some other metall joyned together: and that it will draw further through a slender long iron, then in the free open aire: all which are manifest signes, that iron cooperateth with the force which the loadstone grafteth in it. And the reason why iron cometh to a loadstone more efficaciously then another loadstone doth, is because loadstones generally are more impure then iron is (as being a kind of ore or mine of iron) and have other extraneous and heterogeneall natures mixed with them: whereas iron receiveth the loadstones operation in its whole substance.

CHAP. XXI.

Positions drawn out of the former doctrine, and confirmed by experimentall proofs.

I.
The operations
of the load-
stone are
wrought by
bodies and not
by qualities.

THe first position is, that the working of the loadstone, being throughout according to the tenour of the operation of bodies, may be done by bodies, and consequently is not done by occult or secret qualities. Which is evident out of this, that a greater loadstone hath more effect then a lesser: and that if you cut away part of a loadstone, part of his vertue is likewise taken from him: and if the parts be joyned again, the whole becometh as strong as it was before.

Again, if a loadstone touch a longer iron, it giveth it lesse force then if it touch a shorter iron: nay, the vertue in any part

is sensibly lesser, according as it is further from the touched part.

Again, the longer an iron is in touching, the greater vertue it getteth, and the more constant. And both an iron and a loadstone may lose their vertue, by long lying out of their due order and situation, either to the earth or to another loadstone.

Besides, if a loadstone do touch a long iron in the middle of it, he diffuseth his vertue equally towards both ends; and if it be a round plate, he diffuseth his vertue equally to all sides.

And lastly, the vertue of a loadstone, as also of an iron touched, is lost by burning it in the fire. All which symptomes agreeing exactly with the rules of bodies, do make it undeniable that the vertue of the loadstone is a reall and solid body.

Against this position, Cabeus objecteth that little atomes would not be able to penetrate all sorts of bodies; as we see the vertue of the loadstone doth. And urgeth, that although they should be allowed to do so, yet they could not be imagined to penetrate thick and solid bodies so suddenly, as they would do thin ones; and would certainly shew then some signe of facility or difficulty of passing, in the interposition and in the taking away of bodies put between the loadstone and the body it works upon. Secondly, he objecteth that atomes being little bodies, they cannot move in an instant; as the working of the loadstone seemeth to do. And lastly, that the loadstone by such abundance of continuall evaporations, would quickly be consumed.

2.
Objections against the former position answered.

To the first we answer; That atomes whose nature it is to pierce iron, cannot reasonably be suspected of inability to penetrate any other body: and that atomes can penetrate iron, is evident in the melting of it by fire. And indeed this objection cometh now too late, after we have so largely declared the divisibility of quantity, and the subtilty of nature in reducing all things into extreme small parts: for this difficulty hath no other avow, then the tardity of our imaginations in subtilizing sufficiently the quantitative parts that issue out of the loadstone.

As for any tardity that may be expected by the interposition of a thick or dense body; there is no appearance of such, since we see light passe through thick glasses without giving any signe of meeting with the least opposition in its passage, (as we have above declared at large:) and magneticall emanations have the advantage of light in this, that they are not obliged to straight lines, as light is.

Lastly, as for loadstones spending of themselves by still venting their emanations; odoriferous bodies furnish us with a full answer to that objection: for they do continue many years palpably spending of themselves, and yet keep their odour in vigour; whereas a loadstone, if it be laid in a wrong position will not continue half so long. The reason of the duration of both which, maketh the matter manifest and taketh away all difficulty: which is, that as in a root of a vegetable, there is a power to change the advenient juyce into its nature; so is there in such like things as these a power to change the ambient aire into their own substance: as evident experience sheweth in the Hermetike salt, (as some modern writers call it) which is found to be repaired, and encreased in its weight by lying in the aire; and the like happeneth to saltpeter. And in our present subject experience informeth us, that a loadstone will grow stronger by lying in due position either to the earth, or to a stronger loadstone, whereby it may be better impregnated, and as it were feed it self with the emanations issuing out of them into it.

3.
The loadstone
is imbued with
his virtue from
another body.

Our next position is, that this virtue cometh to a magnetick body, from another body; as the nature of bodies is, to require a being moved, that they may move. And this is evident in iron, which by the touch or by standing in due position near the loadstone, gaineth the power of the loadstone. Again, if a smith in beating his iron into a rod, do observe to lay it north & south; it getteth a direction to the north by the very beating of it. Likewise if an iron rod be made red hot in the fire, and be kept there a good while together, and when it is taken out be laid to cool just north and south, it will acquire the same direction towards the north. And this is true not onely of iron, but also of all other sorts of bodies whatsoever that endure such ignition: particularly of pot-earths, which if they be moulded in a long form, and when they are taken out of the kiln be laid (as we said of the iron) to cool north and south, will have the same effect wrought in them. And iron, though it hath not been heated; but onely hath continued long unmoved in the same situation of north and south in a building; yet it will have the same effect. So as it cannot be denied, but that this virtue cometh unto iron from other bodies: whereof one must be a secret influence from the north. And this is confirmed, by a loadstones losing its virtue (as

we said before) by lying a long time unduly disposed, either towards the earth, or towards a stronger loadstone; whereby instead of the former, it gaineth a new virtue according to that situation.

And this happeneth, not onely in the virtue which is resident and permanent in a loadstone, or a touched iron; but likewise in the actuall motion or operation of them. As may be experienced, first in this, that the same loadstone or touched iron in the south hemisphere of the world, hath its operation strongest at that end of it which tendeth to the north; and in the north hemisphere at the end which tendeth to the south: each pole communicating a vigour proportionable to its own strength in the climate where it is received. Secondly in this, that an iron joynd to a loadstone, or within the sphere of the loadstones working, will take up another piece of iron greater then the loadstone of it self can hold; and as soon as the holding iron is removed out of the sphere of the loadstones activity, it presently letteth fall the iron it formerly held up; and this is so true, that a lesser loadstone may be placed in such sort within the sphere of a greater loadstones operation, as to take away a piece of iron from the greater loadstone; & this in virtue of the same greater loadstone from which it plucketh it: for, but to remove the lesser out of the sphere of the greater, and then it can no longer do it. So that it is evident that in these cases the very actuall operation of the lesser loadstone or of the iron; proceedeth from the actuall influence of the greater loadstone upon and into them. And hence we may understand, that whensoever a magnetick body doth work, it hath an excitation from without, which doth make it issue out and send its streams abroad; in such sort as it is the nature of all bodies to do; and as we have given examples of the like done by heat, when we discoursed of Rarefaction.

But to explicate this point more clearly by entring more particularly into it; if a magnetick body lieth north and south, it is easie & obvious to conceive that the streams coming from north and south of the world, and passing through the stone must needs excitate the virtue which is in it, and carry a stream of it along with them that way they go. But if it lieth east and west, then the streams of north & south of the earth, streaming along by the two poles of the stone, are sucked in by them much more weakly:

yet.

yet nevertheless sufficiently to give an excitation to the innate steams which are in the body of the stone, to make them move on in their ordinary course.

4.

The virtue of the loadstone is a double, and not one simple virtue.

The third position is, that the virtue of the loadstone is a double and not one simple virtue. Which is manifest in an iron touched by a loadstone, for if you touch it onely with one pole of the stone, it will not be so strong and full of the magnetike virtue, as if you touch one end of it with one pole, and the other end of it with the other pole of the stone. Again, if you touch both ends of an iron, with the same pole of the stone, the iron gaineth its virtue at that end which was last touched; and changeth its virtue from end to end, as often as it is rubbed at contrary ends. Again, one end of the loadstone or of iron touched, will have more force on the one side of the equator, and the other end on the other side of it. Again, the variation on the one side of the equator, and the variation on the other side of it, have different lawes according to the different ends of the loadstone, or of the needle, which looketh to those poles.

Wherefore it is evident, that there is a double virtue in the loadstone, the one more powerfull at the one end of it; the other more powerfull at the other end. Yet these two virtues are found in every sensible part of the stone: for cutting it at either end, the virtue at the contrary end is also diminished. And the whole loadstone that is left, hath both the same virtues, in proportion to its bignesse. Besides, cut the loadstone how you will, still the two poles remain in that line, which lay under the meridian when it was in the earth. And the like is of the touched iron whose virtue still lieth along the line, which goeth straight (according to the line of the axis) from the point where it was touched, and at the opposite end, constituteth the contrary pole.

5.

The virtue of the loadstone worketh more strongly in the poles of it, then in any other part.

The fourth position is, that though the virtue of the loadstone be in the whole body; nevertheless, its virtue is more seen in the poles then in any other parts. For by experience it is found that a loadstone of equall bulk, worketh better and more efficaciously if it be in a long form; then if it be in any other. And from the middle line betwixt the two poles, there cometh no virtue, if an iron be touched there: but any part towards the pole; the nearer it is to the pole, the greater party it imparteth. Lastly, the declination teacheth us the same; which is so much the stronger by

The fifth position is, that in the loadstone there are emanations which do issue not onely at the poles and about them, but also spherically, round about the whole body, and in an orb from all parts of the superficies of it; in such sort as happeneth in all other bodies whatsoever. And that these spherical emanations are of two kinds; proportionable to the two polar emanations. And that the greatest force of each sort of them is in that hemisphere where the pole is, at which they make their chief issue.

The reason of the first part of this position is, because no particular body can be exempt from the lawes of all bodies: and we have above declared that every physicall body must of necessity have an orb of fluours, or a sphere of activity about it. The reason of the second part is, that seeing these fluours do proceed out of the very substance and nature of the loadstone, they cannot choose but be found of both sorts, in every part how little soever it be, where the nature of the loadstone resideth. The reason of the third part is, that because the polar emanations do tend wholly towards the poles (each of them to their proper pole) it followeth that in every hemisphere both those which come from the contrary hemisphere, and those which are bred in the hemisphere they go out at, are all assembled in that hemisphere: and therefore of necessity it must be stronger in that kind of fluours, then the opposite end is. All which appeareth true in experience: for if a long iron toucheth any part of that hemisphere of a loadstone which tendeth to the north; it gaineth at that end a virtue of tending likewise to the north: and the same will be if an iron but hang close over it. And this may be confirmed by a like experience, of an iron barre in respect of the earth which hanging downwards in any part of our hemisphere, is imbued with the like inclination of drawing towards the north.

The sixth position is, that although every part of one loadstone do *in it self* agree with every part of another loadstone (that is, if each of these parts were divided from their wholes, and each of them made a whole by it self, they might be so joyned together as they would agree) neverthelesse, when the parts are in their two wholes; they do not all of them agree together: but of two loadstones, only the poles of the one do agree with the whole body of the other; that is, each pole with any part of the contrary hemisphere of the other loadstone.

6.

The loadstone sendeth forth its emanations spherically. Which are of two kinds: and each kind is strongest in that hemisphere, through whose polary parts they issue out.

7.

Putting two loadstones within the sphere of one another, every part of one loadstone doth not agree with every part of the other loadstone.

The reason of this is, because the fluours which issue out of the stones, are in certain different degrees in severall parts of the entire loadstones; whereby it happeneth that one loadstone can work by a determinate part of it self most powerfully upon the other, if some determinate part of that other do lie next unto it; and not so well, if any other part lieth towards it. And accordingly experience sheweth that if you put the pole of a loadstone towards the middle of a needle that is touched at the point, the middle part of the needle will turn away, and the end of it will convert it self to the pole of the loadstone.

8.

Concerning the declination and other respects of a needle, towards the loadstone it toucheth.

The seventh position is, that if a touched needle and a loadstone do come together, and touch one another in their agreeing parts (whatsoever parts of them those be) the line of the needles length will bend towards the pole of the stone (excepting, if they touch by the equator of the stone, and the middle of the needle:) yet not so that if you draw out the line of the needles length, it will go through the pole of the stone; unlesse they touch by the end of the one, and the pole of the other. But if they touch by the equator of the one and the middle of the other, then the needle will lie parallele to the axis of the stone.

And the reason of this is manifest, for in that case the two poles being equidistant to the needle they draw it equally; and by consequence the needle must remain parallele to the axis of the stone. Nor doth it import that the inequality of the two poles of the stone is materially or quantitatively greater then the inequality of the two poles of the needle; out of which it may at the first sight seem to follow, that the stronger pole of the stone should draw the weaker pole of the needle nearer unto it self; then the weaker pole of the stone can be able to draw the stronger pole of the needle: and by consequence that the needle should not lie parallele to the axis of the stone, but should incline somewhat to the stronger pole of it. For after you have well considered the matter, you will find that the strength of the pole of the stone, cannot work according to its materiall greatnesse, but is confined to work onely according to the susceptibility of the needle: the which, being a slender and thin body, cannot receive so much as a thicker body may. Wherefore, seeing that the strongest pole of the stone giveth most strength to that pole of the needle, which lieth farthest from it; it may well happen that

that this superiority of strength in the pole of the needle that is applied to the weaker pole of the stone, may counterpoise the excess of the stronger pole of the stone, over its opposite weaker pole; though not in greatness and quantity, yet in respect of the virtue which is communicable to the poles of the needle; whereby its comportment to the poles of the stone is determined. And indeed the needles lying parallele to the axis of the stone when the middle of it sticketh to the equator of the stone, convinceth that upon the whole matter, there is no excess in the efficacious working of either of the stones poles: but that their excess over one another in regard of themselves is balanced by the needles receiving it.

But if the needle hapneth to touch the loadstone in some part nearer one pole then the other; in this case it is manifest that the force of the stone is greater on the one side of the needles touch, then on the other side; because there is a greater quantity of the stone on the one side of the needle then on the other: and by consequence the needle will incline that way which the greater force draweth it; so far forth as the other part doth not hinder it. Now we know that if the greater part were divided from the rest, and so were an entire loadstone by it self (that is, if the loadstone were cut off where the needle toucheth it) then the needle would joyn it self to the pole, that is to the end, of that part: and by consequence, would be tending to it, in such sort as a thing that is sicked tendeth towards the sicker against the motion or force which cometh from the lesser part: and on the other side the lesser part of the stone which is on the other side of the point which the needle toucheth, must hinder this inclination of the needle according to the proportion of its strength; and so it followeth, that the needle will hang by its end, not directly set to the end of the greater part, but as much inclining towards it as the lesser part doth not hinder by striving to pull it the other way. Out of which we gather the true cause of the needles declination, to wit the proportion of working of the two unequal parts of the stone, between which it toucheth and is joyned to the stone.

And we likewise discover their error who judge that the part which draweth iron is the next pole unto the iron. For it is rather the contrary pole which attracteth; or to speak more

9.
The virtue of
the loadstone
goeth from end

to end in lines
almost paral-
lele to the axis.

properly it is the whole body of the stone as streaming in lines almost parallele to the axis, from the furthermost end, to the other end which is next to the iron; and (in our case) it is that part of the stone which beginneth from the contrary pole and reacheth to the needle. For besides the light which this discourse gave us, experience assureth us that a loadstone, whose poles lie broadwayes, not longwayes, the stone is more imperfect, and draweth more weakly then if the poles lay longwayes; which would not be if the fluours did stream from all parts of the stone directly to the pole: for then, howsoever the stone were cast the whole virtue of it would be in the poles. Moreover, if a needle were drawn freely upon the same meridian from one pole to the other, as soon as it were passed the equator, it would leap suddenly at the very first remove of the equator, where it is parallele with the axis of the loadstone, from being so parallele, to make an angle with the axis greater then a halt right one, to the end that it might look upon the pole which is supposed to be the onely attractive that draweth the needle: which great change, wrought all at once, nature never causeth nor admitteth, but in all actions or motions, useth to passe through all the mediums whensoever it goeth from one extreme to another. Besides, there would be no variation of the needles aspect towards the north end of the stone: for if every part did send its virtue immediately to the poles, it were impossible that any other part whatsoever should be stronger then the polar part, seeing that the polar part had the virtue even of that particular part, and of all the other parts of the stone besides, joyned in it self.

This therefore is evident; that the virtue of the loadstone goeth from end to end in parallele lines; unlesse it be in such stones as have their polar parts narrower then the rest of the body of the stone: for in them the stream will tend with some little declination towards the pole, as it were by way of refraction; because without the stone, the fluours from the pole of the earth do coarct themselves, and so do thicken their stream, to crowd into the stone as soon as they are sensible of any emanations from it, that being (as we have said before) their readiest way to passe along: and within the stone, the stream doth the like to meet the advenient stream where it is strongest and thickest; which is, at that narrow part of the stones end, which is most prominent out.

And

And by this discourse we discover likewise another error of them that imagine the loadstone hath a sphere of activity round about it, equall on all sides; that is, perfectly sphericall, if the stone be sphericall. Which clearly is a mistaken speculation: for nature having so ordered all her agents that where the strength is greatest, there the action must (generally speaking) extend it self furthest off; and it being acknowledged that the loadstone hath greatest strength in its poles and least in the equator; it must of necessity follow, that it worketh further by its poles, then by its equator. And consequently, it is impossible that its sphere of activity should be perfectly sphericall.

Nor doth Cabeus his experience move us to conceive the loadstone hath a greater strength to retain an iron laid upon it by its equator, then by its poles: for to justify his assertion, he should have tried it in an iron wyre that were so short as the poles could not have any notable operation upon the ends of it; since otherwise, the force of retaining it will be attributed to the poles (according to what we have above delivered) & not to the equator.

The eighth position is, that the intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and the attracted bodies. Which is evident out of the sticking of them together: as also out of the violence wherewith iron cometh to a loadstone; which when it is drawn by a powerful one, is so great, that through the force of the blow hitting the stone, it will rebound back again, and then fall again to the stone; and in like manner a needle upon a pinne, if a loadstone be set near it, turneth with so great a force towards the pole of the stone, that it goeth beyond it, and coming back again, the celerity wherewith it moveth maketh it retire it self too far on the other side; and so by many undulations, at the last it cometh to rest directly opposite to the pole. Likewise, by the declination; by means of which, the iron to the stone, or the stone to the earth, approacheth in such a disposition as is most convenient to joyn the due ends together. And lastly, out of the flying away of the contrary ends from one another: which clearly is to no other purpose, but that the due ends may come together. And in generall, there is no doubt but ones going to another, is instituted by the order of nature for their coming together, & for their being together, which is but a perseverance of their coming together.

IO.

The virtue of the loadstone is not perfectly sphericall though the stone be such.

II.

The intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and attracted bodies.

The

12.
The main globe
of the earth is
not a loadstone

The ninth position is, that the nature of a loadstone doth not sink deeply into the main body of the earth, as to have the substance of its whole body be magneticall, but onely remaineth near the surface of it. And this is evident by the inequality in virtue of the two ends; for if this magnetick virtue were the nature of the whole body, both ends would be equally strong. Nor would the disposition of one of the ends be different from the disposition of the other. Again, there could be no variation of the tending towards the north: for the bulk of the whole body would have a strength so eminently greater then the prominences and disparities of hills or seas, as the varieties of these would be absolutely insensible. Again, if the motion of the loadstone came from the body of the earth, it would be perpetually from the center, and not from the poles; and so, there could be no declination more in one part of the earth, then in another. Nor would the loadstone tend from north to south, but from the center to the circumference; or rather from the circumference to the center.

And so we may learn the difference between the loadstone and the earth in their attractive operations; to wit, that the earth doth not receive its influence from another body, nor doth its magnetike virtue depend of another magnetike agent, that impresseth it into it: which neverthelesse, is the most remarkable condition of a loadstone. Again, the strongest virtue of the loadstone, is from pole to pole: but the strongest virtue of the earth, is from the center upwards, as appeareth by fireforks gaining a much greater magnetike strength in a short time, then a loadstone in a longer. Neither can it be thence objected, that the loadstone should therefore receive the earths influences more strongly from the centerwards, then from the poles of the earth, (which by its operation, and what we have discoursed of it, is certain it doth not;) since the beds where loadstones lie and are formed be towards the bottome of that part or back of the earth which is imbued with magnetike virtue. Again, this virtue which we see in a loadstone, is substantiall to it; whereas the like virtue is but accidentall to the earth, by means of the suns drawing the northern and southern exhalations to the equator.

13.
The loadstone
is generated in
all parts or cli-
mates of the
earth.

The last position is, that the loadstone must be found over all the earth, and in every country. And so we see it is: both because iron mines are found (in some measure) almost in all countries: & because,

cause, at the least other sorts of earth (as we have declared of potearths) cannot be wanting in any large extent of country; which when they are baked and cooled in due positions, have this effect of the loadstone; and are of the nature of it. And Doctour Gilbert sheweth, that the loadstone is nothing else but the ore of steel or of perfectest iron, and that it is to be found of all colours, and fashions, and almost of all consistences.

So that we may easily conceive, that the emanations of the loadstone being every where, as well as the causes of gravity; the two motions of magnetick things and of weighty things, do both of them derive their origine from the same source; I mean, from the very same emanations coming from the earth; which by a divers ordination of nature, do make this effect in the loadstone, and that other in weighty things. And who knoweth but that a like sucking to this which we have shewed in magnetick things, passeth also in the motion of gravity? In a word; gravity beareth a fair testimony in the behalf of the magnetick force; and the loadstones working returneth no mean verdict for the causes of gravity, according to what we have delivered of them.

I 4.
The conformity betwixt the two motions of magnetick things, and of heavy things.

CHAP. XXII.

A solution of certain Problemes concerning the loadstone, and a short summe of the whole doctrine touching it.

Of what is said upon this subject, we may proceed to the solution of certain questions or problemes, which are or may be made in this matter. And first, of that which Doctour Gilbert disputeth against all former writers of the loadstone; to wit, which is the North, and which the South pole of a stone? Which seemeth unto me, to be onely a question of the name: for if by the name of north and south, we understand that end of the stone which hath that virtue that the north or south pole of the earth have, then it is certain, that the end of the stone which looketh to the south pole of the earth, is to be called the north pole of the loadstone; and contrariwise, that which looketh to the north, is to be called the south pole of it. But if by the names of north and south pole of the stone, you mean those ends of it, that lie and point to the north and to the south

I.
Which is the North, and which the South Pole of a loadstone.

poles of the earth; then you must reckon their poles contrariwise to the former account. So that the termes being once defined, there will remain no further controversie about the point.

2.
Whether any
bodies besides
magnetick ones
be attractive.

Doctour Gilbert seemeth also to have another controversie with all writers; to wit, whether any bodies besides magneticall ones be attractive? Which he seemeth to deny; all others to affirm. But this also being fairly put, will peradventure prove no controversie: for the question is either in common, of attraction; or else in particular, of such an attraction as is made by the loadstone. Of the first part, there can be no doubt; as we have declared above; and as is manifest betwixt gold and quicksilver, when a man holding gold in his mouth, it draweth unto it the quicksilver that is in his body. But for the attractive to draw a body unto it self, not wholly, but one determinate part of the body drawn, unto one determinate part of the drawer; is an attraction which for my part I cannot exemplifie in any other bodies but magneticall ones.

3.
Whether an
iron placed per-
pendicularly
towards the
earth doth get
a magneticall
virtue of point-
ing towards
the north, or
towards the
south in that
end that lyeth
downwards.

A third question is, whether an iron that standeth long time unmoved in a window, or any other part of a building, perpendicularly to the earth, doth contract a magneticall virtue of drawing or pointing towards the north in that end which looketh downwards. For Cabeus (who wrote since Gilbert) affirmeth it out of experience: but either his experiment or his expression was defective. For assuredly if the iron standeth so, in the northern hemisphere, it will turn to the north; and if in the southern hemisphere, it will turn to the south: for seeing the virtue of the loadstone proceedeth from the earth, and that the earth hath different tempers towards the north, and towards the south pole (as hath been already declared) the virtue which cometh out of the earth in the northern hemisphere, will give unto the end of the iron next it an inclination to the north pole; and the earth of the southern hemisphere will yield the contrary disposition unto the end which is nearest it.

4.
Why loadstones
affect iron bet-
ter then one
another.

The next question is, why a loadstone seemeth to love iron better then it doth another loadstone? The answer is, because iron is indifferent in all its parts to receive the impression of a loadstone; whereas another loadstone receiveth it onely in a determinate part: and therefore a loadstone draweth iron more easily then it can another loadstone; because it findeth repugnance

in the parts of another loadstone, unless it be exactly situated in a right position. Besides, iron seemeth to be compared to a loadstone, like as a more humid body to a dryer of the same nature; and the difference of male and female sexes in animals do manifestly shew the great appetite of conjunction between moisture and dryness, when they belong to bodies of the same species.

Another question is that great one; why a loadstone capped with steel, takes up more iron than it would do if it were without that capping? Another conclusion like unto this, is that if by a loadstone you take up an iron, and by that iron a second iron, and then you pull away the second iron; the first iron (in some position) will leave the loadstone to stick unto the second iron, as long as the second iron is within the sphere of the loadstones activity; but if you remove the second out of that sphere, then the first iron remaining within it, though the other be out of it, will leave the second, and leap back to the loadstone. To the same purpose, is this other conclusion; that the greater the iron is, which is entirely within the compass of the loadstones virtue, the more strongly the loadstone will be moved unto it; and the more forcibly it will stick to it.

The reasons of all these three, we must give at once; for they hang all upon one string. And in my conceit neither Gilbert nor Galileo have hit upon the right. As for Gilbert; he thinketh that in iron there is originally the virtue of the loadstone; but that it is as it were asleep untill by the touch of the loadstone it be awaked and set on work: and therefore the virtue of both joyned together, is greater than the virtue of the loadstone alone.

But if this were the reason, the virtue of the iron would be greater in every regard, and not ouely in sticking or in taking up: whereas himself confesseth, that a capped stone draweth no farther than a naked stone, nor hardly so farre. Besides, it would continue its virtue out of the sphere of activity of the loadstone, which it doth not. Again, seeing that if you compare them severally, the virtue of the loadstone is greater, than the virtue of the iron; why should not the middle iron stick closer to the stone than to the further iron which must of necessity have lesse virtue?

Galileo yieldeth the cause of this effect, that when an iron

5.
Gilberts reason
refuted touch-
ing a capped
loadstone, that
taketh up more
iron then one
not capped;
and an iron
impregnated
that in some
case, draweth
more strongly
then the stone
it self.

Galileus his opinion touching the former effects refused.

toucheth an iron there are more parts which touch one another; then when a loadstone toucheth the iron: both because the loadstone hath generally much impurity in it, and therefore divers parts of it have no virtue; whereas iron, by being melted hath all its parts pure: and secondly, because iron can be smoothed and polished more then a loadstone can be: and therefore its superficies toucheth in a manner with all its parts; whereas divers parts of the stones superficies cannot touch, by reason of its ruggednesse.

And he confirmeth his opinion by experience: for if you put the head of a needle to a bare stone, and the point of it to an iron; and then pluck away the iron; the needle will leave the iron and stick to the stone: but if you turn the needle the other way, it will leave the stone and stick to the iron. Out of which he inferreth that it is the multitude of parts, which causeth the close and strong sticking. And it seemeth he found the same in the capping of his loadstones: for he used flat irons for that purpose; which by their whole plane did take up other irons: whereas Gilbert capped his with convex irons; which not applying themselves to other iron, so strongly or with so many parts as Galileo's did, would not by much take up so great weights as his.

Nevertheless, it seemeth not to me that his answer is sufficient, or that his reasons convince; for we are to consider that the virtue which he putteth in the iron must (according to his own supposition) proceed from the loadstone: and then, what importeth it, whether the superficies of the iron which toucheth another iron, be so exactly plain or no? Or that the parts of it be more solid then the parts of the stone? For all this conduceth nothing to make the virtue greater then it was: since no more virtue can go from one iron to the other, then goeth from the loadstone to the first iron: and if this virtue cannot tie the first iron to the loadstone, it cannot proceed out of this virtue that the second iron be tied to the first. Again, if a paper be put betwixt the cap and another iron, it doth not hinder the magneticall virtue from passing through it to the iron; but the virtue of taking up more weight then the naked stone was able to do, is thereby rendered quite uselesse. Therefore it is evident, that this virtue must be put in something else, and not in the application of the magneticall virtue.

And!

And to examine his reasons particularly, it may very well fall out that whatsoever the cause be, the point of a needle may be too little to make an exact experience in; and therefore a new doctrine ought not lightly be grounded upon what appeareth in the application of that. And likewise, the greatnesse of the surfaces of the two irons may be a condition helpfull to the cause whatsoever it be: for greater and lesser are the common conditions of all bodies, and therefore do avail all kinds of corporeal causes; so that no one cause can be affirmed more then another, merely out of this, that great doth more, and little doth lesse.

To come then to our own solution: I have considered how fire hath in a manner the same effect in iron, as the virtue of the loadstone hath by means of the cap: for I find that fire coming through iron red glowing hot, will burn more strongly, then if it should come immediately through the aire; as also we see that in pitcoal the fire is stronger then in charcole. And nevertheless, the fire will heat further if it come immediately from the source of it, then if it come through a red iron that burneth more violently where it toucheth; and likewise charcoal will heat further then pitcoal, that near hand burneth more fiercely. In the same manner, the loadstone will draw further without a cap then with one; but with a cap it sticketh faster then without one. Whence I see that it is not purely the virtue of the loadstone; but the virtue of it being in iron, which causeth this effect.

Now this modification may proceed either from the multitude of parts which come out of the loadstone and are as it were stopped in the iron; and so the sphere of their activity becometh shorter, but stronger; or else from some quality of the iron joynted to the influence of the loadstone. The first seemeth not to give a good account of the effect; for why should a little paper take it away, seeing we are sure that it stoppeth not the passage of the loadstones influence? Again, the influence of the loadstone seemeth in its motion to be of the nature of light, which goeth in an insensible time as far as it can reach; and therefore were it multiplied in the iron, it would reach further then without it; and from it the virtue of the loadstone would begin a new sphere of activity. Therefore we more willingly cleave to the latter part of our determination.

7.

The Authors
solution to the
former questi-
ons.

And thereupon enquiring what quality there is in iron, whence this effect may follow; we find that it is distinguished from a loadstone, as a metall is from a stone. Now we know that metallals have generally more humidity then stones; and we have discoursed above, that humidity is the cause of sticking: especially when it is litle and dense. These qualities must needs be in the humidity of iron: which of all metallals is the most terrestriall: and such humidity as is able to stick to the influence of the loadstone, as it passeth through the body of the iron, must be exceeding subtil and small; and it seemeth necessary that such humidity should stick to the influence of the loadstone, when it meeteth wth it, considering that the influence is of it self dry, and that the nature of iron is a kin to the loadstone: wherefore the humidity of the one, and the drought of the other will not fail of incorporating together. Now then, if two irons well polished and plain, be united by such a glew as resulteth out of this composition, there is a manifest appearance of much reason for them to stick strongly together. This is confirmed by the nature of iron in very cold countreys & very cold weather: for the very humidity of the aire in times of frost, will make upon iron, sooner then upon other things, such a sticking glew as will pull off the skin of a mans hand that toucheth it hard.

And by this discourse, you will perceive that Galileo's arguments do confirm our opinion as well as his own; and that according to our doctrine, all circumstances must fall out just as they do in his experiences. And the reason is clear why the interposition of another body hindereth the strong sticking of iron to the cap of the loadstone; for it maketh the mediation between them greater, which we have shewed to be the generall reason why things are easily parted.

Let us then proceed to the resolution of the other cases proposed. The second is already resolved: for if this glew be made of the influence of the loadstone, it cannot have force further then the loadstone it self hath: and so farre it must have more force then the bare influence of the loadstone. Or rather the humidity of two irons maketh the glew of a fitter temper to hold, then that which is between a dry loadstone and iron; and the glew entereth better when both sides are moist, then when onely one is so.

But this resolution though it be in part good, yet it doth not evacuate the whole difficulty, since the same case happeneth between a stronger and a weaker loadstone, as between a loadstone and iron: for the weaker loadstone, whilest it is within the sphere of activity of the greater loadstone, draweth away an iron set betwixt them, as well as a second iron doth. For the reason therefore of the little loadstones drawing away the iron, we may consider that the greater loadstone hath two effects upon the iron, which is betwixt it and a lesser loadstone, and a third effect upon the little loadstone it self. The first is that it impregnateth the iron, and giveth it a permanent vertue by which it worketh like a weak loadstone. The second is, that as it maketh the iron work towards the lesser loadstone by its permanent vertue; so also it accompanieth the steam that goeth from the iron towards the little loadstone with its own steam, which goeth the same way: so that both these steams do in company climbe up the steam of the little loadstone which meeteth them; and that steam climbeth up the enlarged one of both theirs together. The third effect which the greater loadstone worketh, is that it maketh the steam of the little loadstone become stronger by augmenting its innate vertue in some degree.

Now then, the going of the iron to either of the loadstones must follow the greater and quicker conjunction of the two meeting steams, and not the greatnesse of one alone. So that if the conjunction of the two steams between the iron and the little loadstone be greater and quicker then the conjunction of the two steams which meet between the greater loadstone and the iron, the iron must stick to the lesser loadstone. And this must happen more often then otherwise: for the steam which goeth from the iron to the greater loadstone, will for the most part be lesse then the steam which goeth from the lesser loadstone to the iron. And though the other steam be never so great, yet it cannot draw more then according to the propotion of its Antagonists coming from the iron. Wherefore seeing the two steams betwixt the iron and the little loadstone are more proportionable to one another, and the steam coming out of the little loadstone is notably greater then the steam going from the iron to the greater loadstone; the conjunction must be made for the most part to the little loadstone. And if this discourse doth not hold

8.

The reason why in the former case, a lesser loadstone doth draw the inter-jacent iron from the greater.

in the former part of the Probleme, betwixt a second iron and a loadstone, it is supplied by the former reason which we gave for that particular purpose.

The third case dependeth also of this solution; for the bigger an iron is, so many more parts it hath to suck up the influence of the loadstone; and consequently, doth it thereby the more greedily: and therefore the loadstone must be carried to it more violently, and when they are joyned stick more strongly.

9. Why the variation of a touched needle from the north, is greater, the nearer you go to the pole.

The sixth question is, Why the variations of the needle from the true north in the northern hemispher, are greater the nearer you go to the pole, and lesser the nearer you approach to the equator. The reason whereof is plain in our doctrine; for considering that the magnetick virtue of the earth, streameth from the north towards the equator; it followeth of necessity, that if there be two streams of magnetick fluours issuing from the north, one of them precisely from the pole, and the other from a part of the earth near the pole; and that the stream coming from the point by side the pole, be but a little the stronger of the two; there will appear very little differences in their severall operations, after they have had a long space to mingle their emanations together; which thereby do joyn and grow as it were into stream. Whereas the nearer you come to the pole, the more you will find them severed, and each of them working by its own virtue. And very near the point which causeth the variation, each stream worketh singly by it self; and therefore here the point of variation must be master, and will carry the needle strongly unto his course from the due north, if his stream be never so little more efficacious then the other.

Again, a line drawn from a point of the earth wide of the pole, to a point of the meridian near the equator, maketh a lesse angle, then a line drawn from the same point of the earth, to a point of the same meridian nearer the pole: wherefore the variation being esteemed by the quantities of the said angles, it must needs be greater near the pole, then near the equator, though the cause be the same.

Which a little figure will presently explicate. Let the point A, be the pole; and the line A B, the meridian; and the point B, the interfection of it, with a parallel near the equator; and the point C the interfection of the meridian with the Tropic;



pick; and D, a point in the earth near the pole, unto which in the said intersection the needle tendeth, in stead of looking directly to the pole, whereby it maketh variation from due north. I say then that the variation of a needle near the equator in the point B, looking upon the point D; cannot be so great and sensible, as the variation of a needle in the Tropick C, looking upon the same point; since the angle D B A, which is made by the variation of the first, is lesse then the angle D C A, which is made by the variation of the latter needle, nearer the pole.

But because it may happen, that in the parts near the equator, the variation may proceed from some picce of land, not much more northerly then where the needle is; but that beareth rather easterly or westerly from it; and yet Gilberts assertion goeth universally, when he saith the variations in southern regions are lesse then in northern ones; we must examine what may be the reason thereof. And presently the generation of the loadstone sheweth it plainly: for seeing the nature of the loadstone proceedeth out of this, that the sunne worketh more upon the torrid zone, then upon the poles; and that his too strong operation is contrary to the loadstone, as being of the nature of fire; it followeth evidently, that the lands of the torrid zone cannot be so magneticall (generally speaking) as the polar lands are; and by consequence, that a lesse land near the pole, will have a greater effect, then a larger continent near the equator: & likewise a land further off towards the pole, will work more strongly then a nearer land which lyeth towards the equator.

The seventh question is, Whether in the same part of the world a touched needle may at one time vary more from the true north point, and at another time lesse? In which Gilbert was resolute for the negative part: but our latter Mathematicians are of another mind. Three experiences were made near London in three divers years. The two first 42 years distant from one another; and the third 12 years distant from the second. And by them it is found, that in the space of 54 years, the loadstone hath at London diminished his variation from the north, the quantity of 7 degrees and more. But so that in the latter years the diminution hath sensibly gone faster then in the former

10.

Whether in the same part of the world a touched needle may at one time vary more from the north, and at another time lesse.

These observations peradventure are but little credited by strangers; but we who know the worth of the men that made them, cannot mistrust any notable errour in them: for they were very able mathematicians, and they made their observations with very great exactnesse; and there were severall judicious witnesses at the making of them; as may be seen in Master Gillebrand his print concerning this subject. And divers other particular persons do confirm the same; whose credit, though each single might peradventure be slighted; yet all in body make a great accession.

We must therefore cast about to find what may be the cause of an effect so paradox to the rest of the doctrine of the loadstone: for seeing that no one place, can stand otherwise to the north of the earth at one time then at another; how is it possible that the needle should receive any new variation, since all variation proceedeth out of the inequality of the earth? But when we consider that this effect proceedeth not out of the main body of the earth, but onely out of the bark of it; and that its bark may have divers tempers not as yet discovered unto us; and that out of the variety of these tempers, the influence of the earthy parts may be divers in respect of one certain place; it is not impossible but that such variation may be, especially in England: which Iland lying open to the north, by a great and vast ocean, may receive more particularly then other places the speciall influences and variation of the weather, that happen in those northeasterly countreyes from whence this influence cometh unto us. If therefore there should be any course of weather, whose period were a hundred years (for example) or more or lesse and so might easily passe unmarked; this variation might grow out of such a course.

But in so obscure a thing, we have already hazarded to guesse too much. And upon the whole matter of the loadstone, it serveth our turn, if we have proved (as we conceive we have done fully) that its motions which appear so admirable, do not proceed from an occult quality; but that the causes of them may be reduced unto locall motion; and that all they may be performed by such corporeall instruments and means (though peradventure more intricately disposed) as all other effects are among bodies. Whose ordering and disposing and particular progresse, there

there is no reason to despair of finding out; would but men carefully apply themselves to that work, upon solid principles and with diligent experiences.

But because this matter hath been very long, and scatteringly diffused in many severall branches; peradventure it will not be displeasing to the Reader to see the whole nature of the loadstone summed up in short. Let him then cast his eyes upon one effect of it, that is very easie to be tried, and is acknowledged by all writers; though we have not as yet mentioned it. And it is, that a knife drawn from the pole of a loadstone towards the equator, if you hold the point towards the pole, it gaineth a respect to one of the poles: but contrariwise, if the point of the knife be held towards the equator, and be thrust the same way it was drawn before (that is, towards the equator) it gaineth a respect towards the contrary pole.

It is evident out of this experience, that the virtue of the loadstone is communicated by way of streams; and that in it, there are two contrary streams: for otherwise the motion of the knife this way or that way could not change the efficacy of the same parts of the loadstone. It is likewise evident, that these contrary streams do come from the contrary ends of the loadstone. As also that the virtues of the both are in every part of the stone. Likewise that one loadstone must of necessity turn certain parts of it self, to certain parts of another loadstone; nay that it must go and joyn to it, according to the laws of attraction which we have above delivered: and consequently, that they must turn their disagreeing parts away from one another; and so one loadstone seem to fly from another, if they be so applied that their disagreeing parts be kept still next to one another: for in this case, the disagreeing and the agreeing parts of the same loadstone, being in the same straight line, one loadstone seeking to draw his agreeing part near to that part of the other loadstone which agreeth with him, must of necessity turn away his disagreeing parts to give way unto his agreeing part to approach nearer.

And thus you see that the flying from one another of two ends of two loadstones, which are both of the same denomination (as for example, the two south ends, or the two north ends) doth not proceed from a pretended antipathy between those

II.

The whole doctrine of the loadstone summed up in short.

those two ends, but from the attraction of the agreeing ends.

Furthermore, the earth, having to a loadstone the nature of a loadstone; it followeth that a loadstone must necessarily turn itself to the poles of the earth by the same laws. And consequently, must tend to the north, must vary from the north, must incline towards the center, and must be affected with all such accidents as we have deduced of the loadstone.

And lastly, seeing that iron is to a loadstone, a fit matter for it to impresse its nature in, and easily retaineth that magnetike virtue; the same effects that follow between two loadstones, must necessarily follow between a loadstone, and a piece of iron fitly proportionated in their degrees: excepting some little particularities, which proceed out of the naturalnesse of the magnetike virtue to a loadstone, more then to iron.

And thus you see the nature of the loadstone summed up in grosse; the particular joynts and causes whereof, you may find treated at large in the main discourse. Wherein we have governed our selves chiefly by the experiences that are recorded by Gilbert and Cabeus; to whom, we remit our reader for a more ample declaration of particulars.

CHAP. XXIII.

A description of the two sorts of living creatures; Plants, and Animals: and how they are framed in common to perform vitall motion.

I.
The connexion
of the follow-
ing Chapters
with the prece-
dent ones.

Hitherto we have endeavoured to follow by a continuall thread, all such effects as we have met with among bodies; and to trace them in all their windings, and to drive them up to their very root and originall source: for the nature of our subject having been yet very common, hath not exceeded the compass and power of our search and inquiry, to descend unto the chief circumstances and particulars belonging unto it. And indeed, many of the conveyances whereby the operations we have discoursed of, are performed, be so secret and abstruse, as they that look into them with lesse heedfulnesse and judgement then such a matter requireth, are too apt to impute them to mysterious causes above the reach of humane nature to comprehend, and to caluminate them of being wrought by occult and specifick qua-

qualities; whereof no more reason could be given, then if the effects were infused by Angelicall hands without assistance of inferiour bodies, which useth to be the last refuge of ignorant men, who not knowing what to say, and yet presuming to say something, do fall often upon such expressions, as neither themselves nor their hearers understand; and that if they be well scanned, do imply contradictions. Therefore we deemed it a kind of necessity to strain our selves to prosecute most of such effects, even to their notionall connexions with rarity and density. And the rather, because it hath not been our luck yet to meet with any that hath had the like designe, or hath done any considerable matter to ease our pains. Which cannot but make the readers journey somewhat tedious unto him to follow all our steps, by reason of the ruggednesse, and untrodnesse of the paths we have walked in.

But now the effects we shall henceforward meddle withall, do grow so particular, and do swarm into such a vast multitude of severall little joynts, and wreathy labyrinths of nature, as were impossible in so summary a treatise, as we intend, to deliver the causes of every one of them exactly; which would require both large discourses and abundance of experiences to acquit our selves as we ought of such a task. Nor is there a like need of doing it as formerly, for as much as concerneth our designe; since the causes of them are palpably materiall, and the admirable artifice of them consisteth onely in the Dedalean and wonderfull ingenious ordering and ranging them one with another.

We shall therefore intreat our Reader from this time forwards to expect onely the common sequels of those particular effects, out of the principles already laid. And when some shall occurre, that may peradventure seem at the first sight to be enacted immediately by a virtue spirituall, and that proceedeth indivisibly; in a different strain from the ordinary processses which we see in bodies and in bodily things (that is, by the virtues of rarity and density, working by locall motion) we hope he will be satisfied at our hands, if we lay down a methode, and trace out a course, whereby such events and operations may follow out of the principles we have laid. Though peradventure we shall not absolutely convince that every effect is done just as we set it down in every particular, and that it may not as well be done by
some

some other disposing of parts under the same generall scope: for it is enough for our turn, if we shew that such effects may be performed by corporeall agents, working as other bodies do, without confining our selves to an exactnesse in every link of the long chain that must be wound up in the performance of them.

2.
Concerning se-
ve-all compo-
sitions of mixed
bodies.

To come then to the matter; The next thing we are to employ our selves about, now that we have explicated the natures of those motions by means whereof bodies are made and destroyed; and in which they are to be considered chiefly as passive, whiles some exterior agent working upon them causeth such alterations in them, and bringeth them to such passe as we see in the changes that are daily wrought among substances; is to take a survey of those motions which some bodies have, wherein they seem to be not so much patients as agents; and do contain within themselves the principle of their own motion; and have no relation to any outward object, more then to stirre up that principle of motion, and set it on work: which when it is once in act, hath as it were within the limits of its own kingdom, and severed from commerce with all other bodies whatsoever, many other subaltern motions over which it presideth.

To which purpose we may consider, that among the compounded bodies whose natures we have explicated; there are some in whom the parts of different complexions are so small and so well mingled together, that they make a compound which to our sense seemeth to be all of it quite through of one homogeneous nature; and howsoever it be divided, each part retaineth the entire and complete nature of the whole. Others again there are, in which it is easie to discern that the whole is made up of severall great parts of very differing natures and tempers.

And of these there are two kinds: the one, of such as their differing parts seem to have no relation to one another, or correspondence together to perform any particular work, in which all of them are necessary; but rather they seem to be made what they are, by chance and by accident; and if one part be severed from another, each is an entire thing by it self, of the same nature as it was in the whole; and no harmony is destroyed by such division. As may be observed in some bodies digged out of mines, in which one may see lumps of metall, ore, stone, and

and glasse, and such different substances, in their severall distinct situations, perfectly compacted into one continuat body, which if you divide, the glasse remaineth what it was before, the Emerald is still an Emerald, the silver is good silver, and the like of the other substances; the causes of which may be easily deduced out of what we have formerly said. But there are other bodies in which this manifest and notable difference of parts, carrieth with it such a subordination of one of them unto another, as we cannot doubt but that nature made such engines (if so I may call them) by designe; and intended that this variety should be in one thing; whose unity and being what it is, should depend of the harmony of the severall differing parts, and should be destroyed by their separation. As we see in living creatures, whose particular parts and members being once severed, there is no longer a living creature to be found among them.

Now, of this kind of bodies there are two sorts. The first is of those that seem to be one continuat substance, wherein we may observe one and the same constant progresse throughout, from the lowest unto the highest part of it; so that the operation of one part is not at all different from that of another: but the whole body seemeth to be the course and throughfare of one constant action, varying it self in diverse occasions and occurrences, according to the disposition of the subject.

The bodies of the second sort, have their parts so notably separated one from the other; and each of them have such a peculiar motion proper unto them, that one might conceive they were every one of them a complete distinct totall thing by it self, and that all of them were artificially tied together; were it not that the subordination of these parts to one another is so great, and the correspondence between them so strict, (the one not being able to subsist without the other, from whom he deriveth what is needfull for him; and again, being so usefull unto that other, and having its action and motion so fitting and necessary for it, as without it that other cannot be:) as plainly convinceth that the compound of all these severall parts must needs be one individuall thing.

I remember that when I travelled in Spain, I saw there two engines that in some sort do expresse the natures of these two kinds of bodies. The one at Toledo, the other at Segovia: both

3.

Two sorts of living creatures.

4.

An engine to expresse the first sort of living creatures.

of

of them set on work by the current of the river, in which the foundation of their machine was laid. That at Toledo was to force up water a great height from the river Tagus to the Alcazar (the Kings pallace) that standeth upon a high steep hill or rock, almost perpendicular over the river. In the bottome there was an indented wheel, which turning round with the stream, gave motion at the same time to the whole engin; which consisted of a multitude of little troughs or square ladles set one over another in two parallel rows over against one another, from the bottome to the top, and upon two severall divided frames of timber. These troughs were closed at one end with a traverse board to retain the water from running out there; which end being bigger then the rest of the trough, made it somewhat like a ladle; and the rest of it seemed to be the handle with a channel in it, the little end of which channel or trough was open to let the water passe freely away. And these troughs were fastened by an axletree in the middle of them, to the frame of timber that went from the bottome up to the top: so that they could upon that center move at liberty, either the shut end downwards, or the open end; like the beam of a balance.

Now at a certain position of the root-wheel (if so I may call it) all one side of the machine sunk down a little lower towards the water; and the other was raised a little higher. Which motion was changed as soon as the ground-wheel had ended the remnant of his revolution: for then the side that was lowest before, sprung up, and the other sunk down. And thus the two sides of the machine were like two legs that by turns trod the water; as in the vintage men presse grapes in a watte. Now the troughs that were fastened to the timber which descended, turned that part of them downwards which was like a box shut to hold the water: and consequently, the open end was up in the aire, like the arm of the balance unto which the lightest scale is fastened: and in the mean time, the troughs upon the ascending timber, were moved by a contrary motion; keeping their box ends aloft, and letting the open ends incline downwards: so that if any water were in them, it would let it run out; whereas the others retained any that came into them.

When you have made an image of this machine in your phantastie,

phantasie, consider what will follow out of its motion. You will perceive that when one leg sinketh down towards the water, that trough which is next to the superficies of it, putting down his box end, and dipping it a little in the water; must needs bring up as much as it can retain, when that leg ascendeth: w^{ch} when it is at its height, the trough moveth upon his own ceter; & the box end, which was lowest, becometh now highest, and so the water runneth out of it. Now the other leg descending at the same time; it falleth out that the trough on its side, which would be a step above that which hath the water in it, if they stood in equilibrium, becometh now a step lower then it: and is so placed, that the water which runneth out of that which is aloft, falleth into the head or box of it; which no sooner hath received it, but that leg on which it is fastned, springeth up, and the other descendeth: so that the water of the second leg, runneth now into the box of the first leg, that is next above that which first laded the water out of the river. And thus, the troughs of the two legs deliver their water by turnes from one side to the other; and at every remove, it getteth a step upwards, till it cometh to the toppe; whiles at every ascent and descent of the whole side, the lowest ladle or trough taketh new water from the river: which ladle full followeth immediately in its ascent, that which was taken up the time before. And thus, in a little while, all the troughs from the bottome to the top are full; unlesse there happen to be some failing in some ladle: and in that case the water breaketh out there; and all the ladles above that are dry.

The other engine, or rather multitude of severall engines, to perform sundry different operations, all conducing to one work (whereas, that of Toledo, is but one tenour of motion, from the first to the last) is in the mine at Segovia. Which is so artificially made, that one part of it, distendeth an ingot of silver or gold into that breadth and thicknesse as is requisite to make coyn of. Which being done, it delivereth the plate it hath wrought, unto another that printeth the figure of the coyn upon it. And from thence it is turned over to another that cutteth it according to the print, into due shape and weight. And lastly, the severall pieces fall into a reserve, in another roome: where the officer, whose charge it is, findeth treasure ready coined; without any thing there, to informe him of the severall

5.
Another engine by which may be expressed the second sort of living creatures.

different motions that the silver or the gold passed before they came to that state. But if he go on the other side of the wall, into the room where the other machines stand and are at work, he will then discern that every one of them, which considered by it self might seem a distinct complete engine, is but a serving part of the whole; whose office is, to make money: and that for this work, any one of them separated from the rest, ceaseth to be the part of a mint, and the whole is maimed and destroyed.

6.

The two former engines and some other comparisons applied to expresse the two severall sorts of living creatures.

Now let us apply the consideration of these different kinds of engines, to the natures of the bodies we treat of. Which I doubt not, would fit much better, were they lively and exactly described. But it is so long since I saw them, and I was then so very young, that I retain but a confused and cloudy remembrance of them: especially of the mint at Segovia, in the which there are many more particulars then I have touched; as conveniency for refining the ore or metall; and then casting it into ingots; and driving them into rods, and such like: unto all which, there is little help of hands requisite, more then to apply the matter duly at the first. But what I have said of them, is enough to illustrate what I aim at: and though I should erre in the particulars, it is no great matter, for I intend not to deliver the history of them: but onely out of the remembrance of such notefull and artificiall masterpieces, to frame a modell in their phancies that shall reade this, of something like them; whereby they may with more ease, make a right conception of what we are handling.

Thus then; all sorts of plants, both great and small, may be compared to our first engine of the waterwork at Toledo; for in them all the motion we can discern, is of one part transmitting unto the next to it, the juice which it received from that immediately before it: so that it hath one constant course from the root (which sucketh it from the earth) unto the top of the highest sprigge: in which if it should be intercepted and stopped by any maiming of the bark (the channell it ascendeth by) it would there break out and turn into drops, or gunne, or some such other substance as the nature of the plant requireth; and all that part of it unto which none of this juice can ascend would drie and wither and grow dead.

But sensible living creatures, we may fitly compare to the second machine of the mint at Segovia. For in them, though every part

part and member be as it were a complete thing of it self, yet every one requireth to be directed and put on its motion by another; and they must all of them (though of very different natures and kinds of motion) conspire together to effect any thing that may be for the use and service of the whole. And thus we find in them perfectly the nature of a mover and a moveable; each of them moving differently from one another, and framing to themselves their own motions, in such sort as is most agreeable to their nature, when that part which setteth them on work hath stirred them up.

And now because these parts (the movers and the moved) are parts of one whole; we call the entire thing *automatum* or *se movens*; or a living creature. Which also may be fitly compared to a joyner, or a painter, or other craftsman, that had his tools so exactly fitted about him, as when he had occasion to do any thing in his trade, his tool for that action were already in the fittest position for it, to be made use of, so as without removing himself from the place where he might sit invironed with his tools, he might, by onely pulling of some little chords, either apply the matter to any remote tool, or any of his tools to the matter he would work upō, according as he findeth the one or the other more convenient for performāce of the action he intēdeth.

Whereas in the other, there is no variety of motions; but one and the same goeth quite through the body from one end of it to the other. And the passage of the moisture through it, from one part to another next (which is all the motion it hath) is in a manner but like the rising of water in a still, which by heat is made to creep up by the sides of the glasse; and from thence runneth through the nose of the limbecke, and falleth into the receiver. So that, if we will say that a plant liveth, or that the whole moveth it self, and every part moveth other; it is to be understood in a farre more imperfect manner, then when we speak of an animall: and the same words are attributed to both, in a kind of equivocall sense. But by the way I must note, that under the title of plants I include not zoophytes or plantanimals: that is such creatures as though they go not from place to place, and so cause a locall motion of their whole substance, yet in their parts, they have a distinct and articulate motion.

But to leave comparisons, and come to the proper nature of the

7.
How plants are
framed.

things: let us frame a conception, that not far under the superficies of the earth, there were gathered together divers parts of little mixed bodies, which in the whole summe were yet but little: and that this little masse had some excesse of fire in it, such as we see in wet hay, or in muste of wine, or in woort of beere: and that withall the drought of it were in so high a degree, as this heat should not find means (being too much compressed) to play his game: and that, lying there in the bosome of the earth, it should after some little time receive its expected and desired drink through the benevolence of the heaven; by which it being moistened, and thereby made more pliable, and tender and easie to be wrought upon, the little parts of fire should break loose; and they finding this moysture a fit subject to work upon, should drive it into all the parts of the little masse, and digesting it there should make the masse swel. Which action taking up long time for performance of it, in respect of the final increase of bulk made in the masse by the swelling of it; could not be hindred by the pressing of the earth, though lying never so weightily upon it: according to the maxime we have above delivered, that any little force, be it never so little; is able to overcome any great resistance, be it never so powerfull; if the force do multiply the time it worketh in, sufficiently to equalise the proportions of the agent and the resistant.

This increase of bulk and swelling of the little masse, will of its own nature be towards all sides, by reason of the fire & heat that occasioneth it (whose motion is on every side, from the center to the circumference:) but it will be most efficacious upwards, towards the aire, because the resistance is least that way; both by reason of the little thicknes of the earth over it; as also by reason that the upper part of the earth lieth very loose and is exceeding porous, through the continuall operation of the sunne and falling of rain upon it. It cannot choose therefore but mount to the aire; and the same cause that maketh it do so, presseth at the same time the lower parts of the masse, downwards. But what ascendeth to the aire, must be of the hotter and more moist parts of the fermenting masse; and what goeth downwards must be of his harder and drier parts proportionate to the contrary motions of fire and of earth, which predominate in these two kinds of parts. Now this that is pushed upwards,
coming

coming above ground, and being there exposed to sunne and wind, contracteth thereby a hard and rough skinne on its outside ; but within is more tender ; in this sort it defendeth it self from outward injuries of weather whiles it mounteth : and by thrusting other parts down into the earth, it holdeth it self stedfast, that although the wind may shake it, yet it cannot overthrow it. The greater this plant groweth, the more juice is dayly accrewed unto it, and the heat is encreased ; and consequently, the greater abundance of humours is continually sent up. Which when it beginneth to clogge at the top, new humour pressing upwards, forceth a breach in the skinne ; and so a new piece, like the main stemme, is thrust out and beginneth on the sides, which we call a branch. Thus is our plant amplified, till nature not being able still to breed such strong issues, falleth to works of lesse labour, and pusheth forth the most elaborate part of the plants juice into more tender substances ; but especially, at the ends of the branches ; where abundant humour, but at the first not well concocted, groweth into the shape of a button ; and more and better concocted humour succeeding, it groweth softer and softer (the sunne drawing the subtillest parts outwards) excepting what the coldnesse of the aire and the roughnesse of the wind do harden into an outward skin. So then the next parts to the the skin are tender ; but the very middle of this button must be hard and dry, by reason that the sun from without, and the naturall heat within, drawing and driving out the moysture and extending it from the center, must needs leave the more earthy parts much shrunk up and hardned by their evaporating out from them : which hardning, being an effect of fire within and without, that baketh this hard substance, incorporateth much of it self with it, as we have formerly declared in the making of salt by force of fire. This button, thus dilated, and brought to this passe, we call the fruit of the plant : whose harder part encloseth oftentimes another not so hard as dry. The reason whereof is because the outward hardnesse permiteth no moysture to soake in any abundance through it ; and then, that which is enclosed in it, must needs be much dried ; though not so much, but that it still retaineth the common nature of the plant. This drought maketh these inner parts to be like a kind of dust ; or at the least, such as

may be easily dried into dust, when they are brused out of the husk that incloseth them: And in every parcell of this dust, the nature of the whole resideth; as it were contracted into a small quantity; for the juice which was first in the button, and had passed from the root through the manifold varieties of the divers parts of the plant, and had suffered much concoction, partly from the sun and partly from the inward heat imprisoned in that harder part of the fruit; is by these passages, strainings and concoctions, become at the length to be like a tincture extracted out of the whole plant; and is at the last dried up into a kind of magistery. This we call the seed: which is of a fit nature, by being buried in the earth and dissolved with humour, to renew and reciprocate the operation we have thus described. And thus, you have the formation of a plant.

8.

How sensitive
creatures are
formed.

But a sensitive creature, being compared to a plant, as a plant is to a mixed body; you cannot but conceive that he must be compounded as it were of many plants, in like sort as a plant is of many mixed bodies. But so, that all the plants which concur to make one animall, are of one kind of nature and cognation; and besides, the matter, of which such diversity is to be made, must of necessity be more humid and figurable, then that of an ordinary plant: and the artificer which worketh and mouldeth it, must be more active. Wherefore we must suppose that the masse, of which an animall is to be made, must be actually liquid: and the fire that worketh upon it, must be so powerfull that of its own nature, it may be able to convert this liquid matter into such breaths and steams, as we see do use to rise from water, when the sun or fire worketh upon it. Yet if the masse were altogether as liquid as water, it would vanish away by heat boyling it, and be dried up: therefore it must be of such a convenient temper, that although in some of its parts it be fluid and apt to run; yet by others it must be held together; as we see that unctuous things for the most part are; which will swell by heat, but not fly away.

So then if we imagine a great heat to be imprisoned in such a liquor; and that it seeketh by boyling, to break out; but that the solidnesse and viscusousnesse of the substance will not permit it to evaporate: it cannot chuse but comport it self in some such sort as we see butter or oyle in a frying pan over the fire, when it

it riseth in bubbles : but much more efficaciously ; for their body is not strong enough to keep in the heat : and therefore those bubbles fall again ; whereas if it were, those bubbles would rise higher and higher, and stretch themselves longer and longer (as when the soap-boylers do boyl a strong unctuous lye into soap ;) and every one of them would be as it were a little brook, whereof the channell would be the enclosing substance ; and the inward smoke that extendeth it, might be compared to the water of it : as when a glasse is blown out by fire and aire into a long figure.

Now we may remember, how we have said, where we treated of the production and resolution of mixed bodies, that there are two sorts of liquid substantiall parts, which by the operation of fire are sent out of the body it worketh upon ; the watery, and the oily parts. For though there appear sometimes some very subtile and ethereall parts of a third kind (which are the aquæ ardentes, or burning spirits ;) yet in such a close distilling of circulation as this is, they are not severed by themselves, but do accompany the rest ; and especially the watery parts : which are of a nature, that the rising Ethereall spirits easily mingle with, and extend themselves in it ; whereby the water becometh more efficacious, and the spirits lesse fugitive.

Of these liquid parts which the fire sendeth away, the watery ones are the first, as being the easiest to be raised : the oily parts rise more difficultly, and therefore do come last. And in the same manner it happeneth in this emission of brooks, the watery and oily steams will each of them fly into different reserves : and if there arrive unto them abundance of their own quality, each of them must make a substance of its own nature by settling in a convenient place, and by due concoction. Which substance after it is made and confirmed, if more humidity and heat do presse it, will again break forth into other little channels. But when the watery and oily parts are boyled away, there remain yet behinde other more solid and fixed parts, and more strongly incorporated with fire then either of these : which yet cannot drie up into a fiery salt, because a continuall accession of humour keepeth them alwayes flowing : and so they become like a coudron of boyling fire. Which must propagate it self as wide as either of the others ; since the

activity of it must needs be greater then theirs (as being the source of motion unto them) and that there wanteth not humidity for it to extend it self by.

And thus you see three roots of three divers plants, all in the same plant, proceeding by naturall resolution from one primitive source. Whereof that which is most watry, is fittest to fabricate the body and common outside of the triformed plant; since water is the most figurable principle that is in nature, and the most susceptible of multiplication; and by its cold is easiest to be hardened, and therefore fittest to resist the injuries of enemy bodies that may infect it. The oily parts are fittest for the continuance and solidity of the plant: for we see that viscosity and oyliness hold together the parts where they abound; and they are slowly wasted by fire, but do conserve and are an aliment to the fire that consumeth them. The parts of the third kind are fittest for the conservation of heat: which though in them it be too violent; yet it is necessary for working upon other parts, and for maintaining a due temper in them.

And thus we have armed our plant with three sorts of rivers or brooks to run through him, with as many different streams; the one of a gentle balsamike oyl; an other, of streaming fire; and the third, of a connaturall and cooler water to irrigate and temper him. The streams of water, (as we have said) must run through the whole fabrick of this triformed plant: and because it is not a simple water, but warm in a good degree, and as it were a middle substance betwixt water and aire (by reason of the ardent volatile spirit that is with it) it is of a fit nature to swell, as aire doth; and yet withall to resist violence in a convenient degree, as water doth. Therefore if from its source nature sendeth abundance into any one part; that part must swell and grow thicker and shorter; and so must be contracted that way which nature hath ordered it. Whence we perceive a means by which nature may draw any part of the outward fabrick, which way soever she is pleased by set instruments for such an effect. But when there is no motion, or but little in these pipes, the standing stream that is in a very little, though long channel, must needs be troubled in its whole body, if any one part of it be pressed upon, so as to receive thereby any impression; and therefore

fore whatsoever is done upon it, though at the very furthest end of it, maketh a commotion and sendeth an impression up to its very source. Which appearing by our former discourse to be the origine of particular and occasionall motions; it is obvious to conceive how it is apt to be moved and wrought by such an impression to set on foot the beginning of any motion; which by natures providence is convenient for the plant, when such an impression is made upon it.

And thus you see this plant hath the virtue both of sense or feeling; that is, of being moved and affected by extern objects, lightly striking upon it; as also of moving it self, to or from such an object; according as nature shall have ordained. Which in summe is; that this plant is a sensitive creature, composed of three sources, the heart, the brain, and the liver: whose off-springs are the arteries, the nerves, and the veins; which are filled with vitall spirits, with animal spirits, and with blood: and by these the animal is heated, nourished, and made partaker of sense and motion.

Now referring the particular motions of living creatures, to another time: we may observe, that both kinds of them, as well vegetables as animals do agree in the nature of sustaining themselves in the three common actions, of generation, nutrition, and augmentation; which are the beginning, the progresse, and the conserving of life. Unto which three we may adde the not so much action as passion of death, and of sicknes or decay, which is the way to death.

CHAP. XXIII.

A more particular survey of the generation of Animals, in which is discovered what part of the animal is first generated.

TO begin then with examining how living creatures are ingendered: our main question shall be, Whether they be framed entirely at once; or successively, one part after an other? And if this latter way; which part first? Upon the discussion of which, all that concerneth generation will be explicated, as much as concerneth our purpose in hand. To deduce this from its origine, we may remember how our Masters tell us, that when any living creature is passed the heat of its augmentation or

I.
The opinion that the seed containeth formally every part of the parent.

grow-

growing; the superfluous nourishment settleth it self in some appointed place of the body to serve for the production of some other. Now it is evident that this superfluity cometh from all parts of the body, and may be said to contain in it after some sort the perfection of the whole living creature. Be it how it will, it is manifest that the living creature is made of this superfluous moisture of the parent: which, according to the opinion of some, being compounded of severall parts derived from the severall limbs of the parent; those parts when they come to be fermented in convenient heat and moisture, do take their posture and situation, according to the posture and disposition of parts that the living creature had from whence they issued: and then they growing daily greater and solider, (the effects of moisture and of heat;) do at the length become such a creature as that was, from whence they had their origine.

Which an accident that I remember, seemeth much to confirm. It was of a cat that had its tail cut off when it was very young: which cat happening afterwards to have young ones, half the kitlings proved without tails, and the other half had them in an ordinary manner; as if nature could supply but one partners side, not on both. And another particular that I saw when I was at Argiers, maketh to this purpose, which was of a woman that having two thumbs upon the left hand; four daughters that she had did all resemble her in the same accident, and so did a little child, a girl of her eldest daughters; but none of her sonnes. Whiles I was there I had a particular curiosity to see them all; and though it be not easily permitted unto Christians to speak familiarly with Mahometan women; yet the condition I was in there, and the civility of the Bassha, gave me the oportunity of full view and discourse with them: and the old woman told me, that her mother and grandmother had been in the same manner. But for them it resteth upon her credit: the others I saw my self.

2.

The former opinion rejected.

But the opinion which these accidents seem to support, though at the first view it seemeth smoothly to satisfy our inquiry, and fairly to compass the making of a living creature: yet looking further into it, we shall find it fall exceeding short of its promising; and meet with such difficulties, as it cannot overcome. For first, let us cast about how this compound of severall parts, that serves

erves for the generation of a new living creature, can be gathered from every part & member of the parent; so to carry with it in little the complete nature of it. The meaning hereof must be, that this superfluous aliment, either passeth through all and every little part and particle of the parents body, and in its passage receiveth something from them : or else, that it receiveth onely from all similar and great parts.

The former seemeth impossible, for how can one imagine that such juyce should circulate the whole body of an animall, and visit every atome of it, and retire to the reserve where it is kept for generation; and no part of it remain absolutely behind, sticking to the flesh or bones that it bedeweth; but that still some part returneth back from every part of the animal? Besides, consider how those parts that are most remote from the channels which convey this juyce; when they are fuller of nourishment then they need, the juyce which overfloweth from them, cometh to the next part, and settling there and serving it for its due nourishment, driveth back into the channell, that which was betwixt the channell and it self; so that here there is no return at all from some of the remote parts; and much of that juyce which is rejected, never went far from the channell it self. We may therefore safely conclude, that it is impossible every little part of the whole body should remit something impregnated and imbued with the nature of it.

But then you may peradventure say, that every similar part doth. If so, I would ask, how it is possible that by fermentation onely, every part should regularly go to a determinate place, to make that kind of animal; in which every similar part is diffused to so great an extent? How should the nature of flesh here become broad, there round, and take just the figure of the part it is to cover? How should a bone here be hollow, there be blady, and in another part take the form of a rib, and those many figures which we see of bones? And the like we might ask of every other similar part, as of the veins and the rest. Again, seeing it must of necessity happen, that at one time more is remitted from one part then from another; how cometh it to passe, that in the collection the due proportion of nature is so punctually observed? Shall we say that this is done by some cunning artificer, whose work it is to set all these parts in their due posture; which

Aristotle attributeth to the seed of the male? But this is impossible; for all this diversity of work is to be done at one time, and in the same occasions: which can no more be effected by one agent, then multiplicity can immediately proceed from unity.

But besides that there can be no agent to dispose of the parts when they are gathered; it is evident that a sensitive creature may be made without any such gathering of parts beforehand from an other of the same kind: for else, how could vermine breed out of living bodies, or out of corruption? How could rats come to fill ships, into which never any were brought? How could frogs be ingendred in the aire? Eels of dewy turfs, or of mud? Toads of ducks? Fish of herns? and the like. To the same purpose; when one species or kind of animal is changed into another; as when a caterpillar or a silk-worm becometh a flie; it is manifest that there can be no such precedent collection of parts.

3.

The Authours
opinion of this
question.

And therefore there is no remedy but we must seek out some other means and course of generation, then this. Unto which we may be lead, by considering how a living creature is nourished and augmented: for why should not the parts be made in generation of a matter like to that which maketh them in nutrition? If they be augmented by one kind of juyce that after severall changes turneth at the length into flesh and bone; and into every sort of mixed body or similar part, whereof the sensitive creature is compounded; and that joyneth it self to what it findeth already made, why should not the same juyce with the same progresse of heat and moisture, and other due temperaments, be converted at the first into flesh and bone, though none be formerly there to joyn it self unto?

Let us then conclude that the juyce which serveth for nourishment of the animal, being more then is requisite for that service; the superfluous part of it is drained from the rest, and is reserved in a place fit for it: where by little and little through digestion, it gaineth strength, and vigour, and spirits to it self, and becometh an homogeneous body, such as other simple compounds are; which by other degrees of heat and moisture, is changed into an other kind of substance: and that again by other temperaments into another. And thus, by the course of nature, and by passing successively many degrees of temper, and by receiving a totall change

change in every one of them; at the length an animal is made of such juyce as afterwards serveth to nourish him.

But to bring this to passe a shorter way, and with greater facility; some have been of opinion, that all similar things of whatsoever substance, are undiscernably mixed in every thing that is: and that to the making of any body out of any thing, there is no more required but to gather together those parts which are of that kind, and to separate, and cast away from them, all those which are of a nature differing from them.

4.
Their opinion refused, who hold that every thing containeth formally all things.

But this speculation will appear a very airy & needlesse one, if we consider into how many severall substances the same species of a thing may be immediately changed; or rather how many severall substances may be increased immediately from severall equall individuals of the same thing; and then take an account how much of each individuall is gone into each substance which it hath so increased. For if we summe up the quantities that in the severall substances are thereby increased; we shall find that they do very much exceed the whole quantity of any one of the individuals: which should not be if the supposition were true; for every individuall should be but one totall made up of the severall different similar parts, which increase the severall substances, that extract out of them what is of their own nature.

This will be better understood by an example: suppose that a man, a horse, a cow, a sheep, and 500. more severall species of living creatures, should make a meal of letuce: to avoid all perplexity in conceiving the argument, let us allow that every one did eat a pound; and let us conceive another pound of this herb to be burned; as much to be putrified under a cabage root; and the like under 500 plants more of diverse species. Then cast how much of every pound of letuce is turned into the substances that are made of them, or that are increased by them; as, how much ashes one pound hath made; how much water hath been distilled out of another pound; how much a man hath been increased by a third; how much a horse by a fourth; how much earth by the putrefaction of a fifth pound; how much a cabage hath been increased by a sixth: and so go over all the pounds that have been turned into substances of different specieses (which may be multiplied as much as you please.) And when you have summed up all

all these severall quantities, you will find them far to exceed the quantity of one pound: which it would not do, if every pound of letuce were made up of severall different similar parts actually in it, that are extracted by different substances of the natures of those parts; and that no substance could be increased by it, unlesse parts of its nature were originally in the letuce.

5.
The Authors
opinion concern-
ing the gene-
ration of ani-
mals declared
and confirmed.

On the other side, if we but cast our eye back upon the principles we have laid, where we discourse of the composition of bodies; we shall discern how this work of changing one thing into another, either in nutrition, in augmentation, or in generation; will appear not onely possible, but easie to be effected. For out of them it is made evident how the severall varieties of solid and liquid bodies; all differences of naturall qualities, all consistences, and whatsoever else belongeth to similar bodies; resulteth out of the pure and single mixture of rarity and density; so that to make all such varieties as are necessary, there is no need of mingling, or of separating any other kinds of parts: but onely an art or power to mingle in due manner, plain, rare and dense bodies one with an other. Which very action and none other (but with excellent method and order, such as becometh the great Architect that hath designed it) is performed in the generation of a living creature : which is made of a substance at the first, farre unlike what it afterwards groweth to be.

If we look upon this change in grosse, and consider but the two extremes (to wit, the first substance, of which a living creature is made; and it self in its full perfection) I confesse, it may well seem incredible how so excellent a creature can derive its origine from so mean a principle, and so far remote and differing from what it groweth to be. But if we examine it in retail, and go along anatomising it in every step and degree that it changeth by; we shall find that every immediate change is so near, and so palpably to be made by the concurrent causes of the matter prepared; as we must conclude it cannot possibly become any other thing then just what it doth become.

Take a bean, or any other seed, and put it into the earth, and let water fall upon it; can it then choose but that the bean must swell? The bean swelling, can it choose but break the skin? The skin broken, can it choose (by reason of the heat that is in it) but

but push out more matter, and do that action which we may call germinating? Can these germs choose but pierce the earth in small strings, as they are able to make their way? Can these strings choose but be hardened, by the compression of the earth, and by their own nature, they being the heaviest parts of the fermented bean? And can all this be any thing else but a root? Afterwards the heat that is in the root, mingling it self with more moisture, and according to its nature, springing upwards; will it not follow necessarily, that a tender green substance (which we call a bud, or leaf) must appear a little above the earth; since tenderesse, greenesse, and ascent, are the effects of those two principles, heat and moisture? And must not this green substance change from what it was at the first, by the sunne and aire working upon it, as it groweth higher; till at the length it hardeneth into a stalk? All this while, the heat in the root sublimeth up more moisture, which maketh the stalk at the first grow rank and increase in length. But when the more volatile part of that warm juice, is sufficiently depured and sublimed, will it not attempt to thrust it self out beyond the stalk with much vigour and smartnesse? And as soon as it meeteth with the cold aire in its eruption, will it not be stopped and thickned? And new parts flocking still from the root, must they not clog that issue, and grow into a button, which will be a bud? This bud being hardened at the sides, by the same causes which hardened the stalk, and all the while the inward heat still streaming up, and not enduring to be long enclosed, (especially when by its being stopped, it multiplyeth it self) will it not follow necessarily that the tender bud must cleave, and give way to that spirituall juice; which being purer then the rest (through its great sublimation) sheweth it self in a purer and nobler substance then any that is yet made; and so becometh a flower? From hence, if we proceed as we have begun, and do weigh all circumstances; we shall see evidently, that another substance must needs succeed the flower, which must be hollow and contain a fruit in it: and that this fruit must grow bigger and harder. And so, to the last period of the generation of new beans.

Thus by drawing the thrid carefully along through your fingers, and staying at every knot to examine how it is tyed; you see that this difficult progresse of the generation of living creatures,

creatures, is obvious enough to be comprehended; and that the steps of it are possible to be set down; if one would but take the pains and afford the time that is necessary (lesse then that Philosopher, who for so many years gave himself wholly up to the single observing of the nature of bees) to note diligently all the circumstances in every change of it. In every one of which the thing that was, becometh absolutely a new thing; and is endued with new properties and qualities different from those it had before, as Physicians from their certain experience do assure us. And yet every change is such, as in the ordinary and generall course of nature (wherein nothing is to be considered, but the necessary effects following out of such Agents working upon such patients, in such circumstances) it is impossible that any other thing should be made of the precedent, but that which is immediately subsequent unto it.

Now if all this orderly succession of mutations be necessarily made in a bean, by force of sundry circumstances, and externall accidents; why may it not be conceived that the like is also done in sensible creatures; but in a more perfect manner, they being perfecter substances? Surely the progresse we have set down is much more reasonable, then to conceive that in the meal of the bean are contained in little, severall similar substances; as, of a root, of a leaf, a stalk, a flower, a pod, fruit, and the rest; and that every one of these, being from the first still the same that they shall be afterwards, do but suck in more moisture from the earth, to swell and enlarge themselves in quantity. Or, that in the seed of the male, there is already in act, the substance of flesh, of bone, of sinews, of veins, and the rest of those severall similar parts which are found in the body of an animal; and that they are but extended to their due magnitude, by the humidity drawn from the mother, without receiving any substantiall mutation from what they were originally in the seed.

Let us then confidently conclude, that all generation is made of a fitting, but remote, homogeneall compounded substance; upon which, outward Agents, working in the due course of nature, do change it into another substance, quite different from the first, and do make it lesse homogeneall then the first was. And other circumstances & agents do change this second into a third; that third, into a fourth; and so onwards, by successive mutations (that

(that still make every new thing become lesse homogeneous, then the former was, according to the nature of heat, mingling more and more different bodies together) untill that substance be produced, which we consider in the period of all these mutations.

And this is evident out of many experiences: as for example in trees; the bark which is opposed to the north wind, is harder and thicker then the contrary side which is opposed to the south, and a great difference will appear in the grain of the wood; even so much, that skilfull people will by feeling and seeing a round piece of the wood after the tree is felled, tell you in what situation it grew, and which way each side of that piece looked. And Josephus Acoſta writeth of a tree in America, that on the one side being situated towards great hills, and on the other being exposed to the hot sunne; the one half of it flourisheth at one time of the year, and the other half at the opposite season. And some such like may be the cause of the strange effects we sometimes see of trees, flourishing or bearing leaſe at an unseasonable time of the year; as in particular, in the famous oke in the New-forest; and in some others in our Island: in which peradventure the soyl they grow in, may do the same effect, as the winds and sunne did in the tree that Acoſta maketh mention of. For we dayly see how some soils are so powerfull over some kind of corn, that they will change the very nature of it; so that, you shall reap oats or rie, after you have sown wheat there.

Which sheweth evidently that since the outward circumstances can make the parts or the whole of any substance, become different from what they were at the first; generation is not made by aggregation of like parts to presupposed like ones; nor by a specificall worker within; but by the compounding of a feminary matter, with the juice which accrueeth to it from without, and with the steams of circumstant bodies; which by an ordinary course of nature, are regularly imbibed in it by degrees; and which at every degree, do change it into a different thing, such an one as is capable to result out of the present compound, (as we have said before) untill it arrive to its full perfection.

Which yet is not the utmost period of natures changes; for

That one substance is changed into another.

from that, for example, from corn or an animal, it carryeth it on (still changing it) to be meal or a cadaver: from thence to be bread or durt: after that to be blond or grasse. And so, still turning about her wheel (which suffereth nothing to remain long in the state it is in) she changeth all substances from one into another. And by reiterated revolutions, maketh in time every thing of every thing: as when of mud she maketh tadpoles, and frogs of them; and afterwards, mud again of the frogs: or when she runneth a like progresse; from earth to worms; and from them, to flies; and the like: so changing one animall into such another; as in the next precedent step, the matter in those circumstances is capable of being changed into; or rather (to say better) must necessarily be changed into.

To confirm this by experience; I have been assured, by one who was very exact in noting such things; that he once observed in Spain, in the spring season, how a stick lying in a moist place, grew in tract of time to be most of it a rotten dirty matter; and that at the dirty end of the stick, there began a rude head to be formed of it by little and little; and after a while some little legs began to discover themselves near this unpolished head, which dayly grew more and more distinctly shaped. And then, for a pretty while (for it was in a place where he had the conveniencie to observe dayly the progresse of it, and no body came near to stirre it in the whole course of it) he could discern where it ceased to be a body of a living creature, and where it began to be dead stick or dirt; all in one continue quantity or body. But every day the body grew longer and longer, and more legs appeared, till at the length, when he saw the animall almost finished, and near separating it self from the rest of the stick, he stayed then by it, and saw it creep away in a caterpillar, leaving the stick and dirt, as much wanting of its first length, as the worms body took up. Peradventure the greatest part of such creatures maketh their way by such steps into the world. But to be able to observe their progresse thus distinctly as this Gentleman did, happeneth not frequently.

7^a
Concerning
the teaching of

Therefore, to satisfie our selves herein it were well we made our remarks in some creatures that might be continually in our power

power to observe in them the course of nature every day and houre. Sir John Heydon, the Lieutenant of his Majesties ordinance (that generous and knowing Gentleman; and consummate souldier both in theory and practise) was the first that instructed me how to do this, by means of a furnace so made as to imitate the warmth of a sitting henne. In which you may lay severall egges to harch; and by breaking them at severall ages you may distinctly observe every hourely mutation in them, if you please. The first will be, that on one side you shall find a great resplendent clearnesse in the white. After a while, a little spot of red matter like bloud, will appear in the midst of that clearnesse fastened to the yolk: which will have a motion of opening and shutting; so as sometimes you will see it, and straight again it will vanish from your sight; and indeed at the first it is so little, that you cannot see it, but by the motion of it; for at every pulse, as it openeth, you may see it, and immediately again, it shutteth in such sort, as it is not to be discerned. From this red speck, after a while there will stream out, a number of little (almost imperceptible) red veins. At the end of some of which, in time there will be gathered together, a knot of matter which by little and little will take the form of a head; and you will ere long begin to discern eyes and a beak in it. All this while the first red spot of bloud, groweth bigger and soulder: till at the length, it becometh a fleshy substance; and by its figure, may easily be discerned to be the heart: which as yet hath no other enclosure but the substance of the egge. But by little and little the rest of the body of an animal is framed out of those red veins which stream out all about from the heart. And in proesse of time, that body incloseth the heart within it by the chest, which groweth over on both sides, and in the end meeteth, and closeth it self fast together. After which this little creature soon filleth the shell, by converting into severall parts of it self all the substance of the egge. And then growing weary of so straight an habitation, it breaketh prison, and cometh out, a perfectly formed chicken.

In like manner: in other creatures; which in latine are called *Vivipara* (because their young ones are quick in their mothers wombe) we have, by the relation of that learned and ex-

chickens, and
the generation
of other ani-
mals.

aſt ſearcher into nature, Doctour Harvey : that the ſeed of the male after his accoupling with the female, doth not remain in her wombe in any ſenſible bulk : but (as it ſeemeth) evaporateth and incorporateth it ſelf, either into the body of the wombe, or rather into ſome more interior part, as into the ſeminary veſſels. Which being a ſolid ſubſtance, much reſembling the nature of the females ſeed, is likely to ſuck up, by the mediation of the females ſeed, the males ſeed incorporated with it, and by incorporation, turned as it were into a vapour: in ſuch ſort as we have formerly explicated how the body of a ſcorpion or viper draweth the poyſon out of a wound. And after a certain time (Doctour Harvey noted the ſpace of ſix weeks or two months in does or hindes) theſe ſeeds diſtill again into the wombe; and by little and little do clarifie in the miſt, and a little red ſpeck appeareth in the center of the bright clearneſſe: as we ſaid before of the egge.

8.

From whence it happeneth that the deficiencies, or excreſcences of the parents body are often ſeen in their children.

But we ſhould be too blame to leave our Reader without clearing that difficulty, which cannot chooſe but have ſprung up in his thoughts, by occaſion of the relations we made at the entrance into this point concerning the cat whoſe kitlings were half with tails, and half without: and the womans daughters at Argiers, that had as well as their mother excreſcences upon their left thumbs, imitating another leſſer thumb: and the like effects whenſoever they happen, which they do frequently enough.

Let him therefore remember, how we have determined that generation is made of the bloud, which being diſperſed into all the parts of the body to irrigate every one of them; and to convey fitting ſpirits into them from their ſource or ſhop where they are forged; ſo much of it as is ſuperabundant to the nourishing of thoſe parts is ſent back again to the heart to recover the warmth and ſpirits it hath loſt by ſo long a journey. By which perpetuall courſe of a continued circulation, it is evident that the bloud in running thus through all the parts of the body muſt needs receive ſome particular concoction or impreſſion from every one of them. And by conſequence, if there be any ſpecificall virtue in one part which is not in another, then the bloud returning
from

from thence must be endued with the virtue of that part. And the purest part of this blood, being extracted like a quintessence out of the whole masse, is reserved in convenient receptacles or vessels till there be use of it: and is the matter or seed, of which a new animall is to be made; in whom, will appear the effect of all the specificall virtues drawn by the blood in its iterated courses, by its circular motion, through all the severall parts of the parents body.

Whence it followeth, that if any part be wanting in the body whereof this seed is made, or be superabundant in it; whose virtue is not in the rest of the body, or whose superabundance is not allaid by the rest of the body; the virtue of that part, cannot be in the blood, or will be too strong in the blood, and by consequence, it cannot be at all, or it will be too much in the seed. And the effect proceeding from the seed, that is, the young animal will come into the world favouring of that origine; unlesse the mothers seed, do supply or temper, what the fathers was defective or superabundant in; or contrariwise the fathers do correct the errors of the mothers.

But peradventure the Reader will tell us, that such a specificall virtue cannot be gotten by concoction of the blood, or by any pretended impression in it; unlesse some little particles of the nourished part do remain in the blood, and return back with it, according to that maxime of Geber, *Quod non ingreditur, non immutat*: no body can change another unlesse it enter into it, and mixing it self with it do become one with it. And that so in effect, by this explication we fall back into the opinion which we rejected.

To this I answer, that the difference is very great between that opinion and ours; as will appear evidently, if you observe the two following assertions of theirs. First, they affirm that a living creature is made merely by the assembling together of similar parts, which were hidden in those bodies from whence they are extracted in generation: whereas we say that blood coming to a part to irrigate it, is by its passage through it, and some little stay in it, and by its frequent returns thither, at the length transmuted into the nature of that part: and thereby the specificall virtues of every part do grow greater, and are more diffused and extended.

9.
The difference
between the
Authors opi-
nion, and the
former one.

Secondly, they say that the embryo is actually formed in the seed, though in such little parts as it cannot be discerned untill each part have enlarged and increased it self, by drawing unto it from the circumstant bodies more substance of their own nature. But we say, that there is one homogeneous substance, made of the blood, which hath been in all parts of the body; and this is the seed: which containeth not in it, any figure of the animal from which it is refined, or of the animal into which it hath a capacity to be turned (by the addition of other substances) though it have in it the vertues of all the parts it hath often run through.

By which term of specificke vertues, I hope we have said enough in sundry places of this discourse to keep men from conceiving that we do mean any such unconceivable quality, as modern Philosophers too frequently talk of, when they know not what they say or think, nor can give any account of. But that it is such degrees and such numbers, of rare and dense parts mingled together, as constitute a mixed body of such a temper and nature: which degrees and proportions of rare and dense parts and their mixture together, and incorporating into one homogeneous substance, is the effect resulting from the operations of the exterior agent, that cutteth, imbibeth, kneadeth, and boyleth it to such a temper: which exterior agent in this case, is each severall part of the animals body that this juice or blood runneth through; and that hath a particuler temper belonging to it, resulting out of such a proportion of rare and dense parts, as we have even now spoken of; and can no more be withheld from communicating its temper to the blood that first soaketh into it, and soon after draineth away again from it (according as other succeeding parts of blood drive it on;) then a minerall channell can choose but communicate its vertue unto a stream of water that runneth through it, and is continually grating of some of the substance of the minerall earth, and dissolving it into it self.

But to go on with our intended discourse: The seed, thus imbued with the specificall vertues of all the severall parts of the parents body, meeting in a fit receptacle the other parents seed; and being there duly concocted, becometh first a heart: which heart:

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That the heart
is imbued with
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tues of, the

heart in this tender beginning of a new animal containeth the severall virtues of all the parts that afterwards will grow out of it, and be in the future animal; in the same manner as the heart of a cōplete animal containeth in it the specifike virtues of all the severall parts of its own body, by reason of the blouds continuall resorting to it in a circle from all parts of its body, and its being nourished by that juice to supply the continuall consumption which the extreme heat of it must needs continually occasion in its own substance; whereby the heart becometh in a manner the compendium or abridgement of the whole animal.

whole body;
whereby is
confirmed the
doctrine of the
two former
paragraphes.

Now this heart in the growing Embryon, being of the nature of fire, as on the one side it streaineth out its hot parts; so on the other it sucketh oyl or fewel to nourish it self out of the adjacent moist parts; which matter aggregated unto it, being sent abroad together with the other hot parts that steam from it; both of them together do stay and settle as soon as they are out of the reach of that violent heat, that would not permit them to thicken or to rest. And there they grow into such a substance as is capable to be made of such a mixture, and are linked to the heart by some of those strings that steam out from it. (for those steams do likewise harden, as we shewed more particularly when we discoursed of the tender stalks of plants) and in a word, this becometh some other part of the animal. Which thus encreaseth by order, one part being made after another, untill the whole living creature be completely framed.

So that now you see, how mainly their opinion differeth from ours; since they say that there is actually in the seed a complete living creature; for what else is a living creature, but bones in such parts, nerves in such others, bloud and humours contained in such and such places, all as in a living creature? All which they say. But we make the seed to be nothing else but one mixed body, of one homogeneous nature throughout; consisting of such a multiplicity of rare and dense parts; so ballanced and proportioned in number and in magnitude of those parts; which are evenly shuffled, and alike mingled in every little parcel of the whole substance; in such sort, that the operati-

on of nature upon this seed, may in a long time and with a due processe, bring out such figures, situation, and qualities (as fluidity, consistence, drinesse, and the like) which by much mixture and consequent alteration, may in the end become such as constitute a living creature of such a kind. And thus it appeareth that although other substances, and liquours, and steams are from time to time mingled with the seed, and then with the heart, and afterwards with the other parts, as they grow on and encrease; yet the main virtue of the ensuing animal, is first in the seed, and afterwards in the heart.

Whence the reason is evident, why both defects and excesses do passe sometimes from the parents to the children; to wit, when nothing supplyeth the defect or correcteth the exorbitancy. Rather after this which we have said, the difficulty will appear greater, in that such accidents are not alwayes hereditary from the parents; but happen only now & then some rare-times. But the same grounds we have laid will likewise solve this objection: for seeing that the heart of the animal, from whence the seed receiveth its proper nature (as we have declared) is impregnated with the specifick virtue of each severall part of the body; it cannot be doubted but that the heart will supply for any defect happened in any part. after it hath been imbued with that virtue, and is grown to a firmnesse, and vigorous consistence with that virtue moulded, and deeply imbibed into the very substance of it. And although the heart should be tainted from its first origine with an undue virtue from some part (as it seemeth to have been in the mother of those daughters that had two thumbs upon one hand:) yet it is not necessary that all the offspring of that parent should be formed after that modell; for the other partners seed may be more efficacious, and predominate in the geniture, over the faulty seed of the other parent; and then it will supply for and correct the others deviation from the generall rule of nature. Which seemeth to be the case of that womans male children; for in them the fathers seed being strongest, all their fingers imitated the regularity of their fathers: whereas the daughters (whose sex implieth that the fathers seed was lesse active) carried upon some of theirs, the resemblance of their mothers irregularity.

And

And in confirmation of this doctrine, we daily see that the children of parents who have any of their noble parts much and long distempered, whereby there must be a great distemper in the blood (which is made and concocted by their assistance) do seldome fail of having strong inclinations to the distempers and diseases that either of their parents were violently subject unto. Scarce any father or mother dieth of the consumption of the lungs, but their children inherit that disease in some measure: the like is of the stone; the like of the gout; the like of diseases of the brain, and of sundry others; when they infected the parents with any notable eminency. For the blood coming continually to the heart from such ill-affected parts, by its circulation through the whole body, must needs in proesse of time alter, and change the temper of the heart: and then both the heart giveth a tainted impression to the blood that must be boyled into seed; and the parts themselves do communicate their debilities and distempers unto it: so that it is no wonder, if the seed do partake of such depraved qualities; since it is a maxime among Physicians, that subsequent concoctions can never amend or repair the faults of the precedent ones.

Having waded thus farre into this matter, and all experience agreeing that the whole animal is not formed at once: I conceive there can be no great difficulty in determining what part of it is first generated: which we have already said to be the heart; but peradventure the Reader may expect some more particular and immediate proof of it. It is evident that all the motions and changes which we have observed in the egge and in the Doe, do proceed from heat: and it is as certain that heat is greatest in the center of it: from whence it disperseth it self to lesse and lesse. It must then necessarily follow, that the part in which heat doth most abound, and which is the interiour fountain of it, from whence (as from a stock of their own) all the other parts derive theirs; must be formed first and the others successively after it, according as they partake more or lesse of this heat; which is the Architect that mouldeth and frameth them all. Undoubtedly this can be none other but the heart: whose motion and manner of working, evidently appears in the twinkling of the first red spot (which is the first change) in the egge, and in the first

II.

That the heart is the first part generated in a living creature.

first matter of other living creatures. Yet I do not intend to say, that the heart is perfectly framed, and completely made up, with all its parts and instruments, before any other part be begun to be made: but onely the most vertuous part; and as it were the marrow of it; which serveth as a shop or a hot forge to mould spirits in: from whence they are dispersed abroad to form and nourish other parts that stand in need of them to that effect.

The shootings or little red strings that stream out from it, must surely be arteries; through which, the blood issuing from the heart, and there made and imbued with the nature of the seed, doth runne; till encountering with fit matter, it engrosseth it self into brain, liver, lights, &c. From the brain chiefly groweth the marrow, and by consequent, the bones containing it, (which seem to be originally, but the outward part of the marrow, baked and hardened into a strong crust by the great heat that is kept in:) as also the sinews; which are the next principall bodies of strength, after the bones. The marrow being very hot drieth the bones; and yet with its actuall moysture it humecteth and nourisheth them too, in some sort. The spirits that are sent from the brain do the like to the sinewes. And lastly, the arteries and veins by their blood do cherish and bedew the flesh. And thus the whole living creature is begun, framed, and made up.

CHAP. XXV.

How a Plant or Animall cometh to that figure it hath.

I.
That the figure of an Animall is produced by ordinary second causes, as well as any other corporeall effect.

BUT before we go any further, and search into the operations of this animall, a wonderfull effect calleth our consideration unto it: which is, how a plant or animall cometh by the figure it hath, both in the whole and in every part of it? Aristotle, after he had beaten his thoughts as far as he could upon this question, pronounced that this effect could not possibly be wrought by the virtue of the first qualities; but that it sprung from a more divine origine. And most of the contemplatours of Nature since him do seem to agree, that no cause can be rendered of it; but that it is to be referred merely to the specificall nature

nature of the thing. Neither do we intend to derogate from either of these causes; since that both divine providence is eminently shown in contriving all circumstances necessary for this work; and likewise, the first temperament that is in the seed must needs be the principall immediate cause of this admirable effect.

This latter then being supposed; our labour and endeavour will be, to unfold (as farre as so weak and dimme eyes can reach) the excellency and exactnesse of Gods providence, which cannot be enough adored, when it is reflected upon, and marked in the apt laying of adequate causes to produce such a figure out of such a mixture first layed. From them so artificially ranged, we shall see this miracle of nature to proceed; and not from an immediate working of God or nature without convenient and ordinary instruments to mediate and effect this configuration, through the force and virtue of their own particular natures. Such a necessity to interest the chief workman at every turn, in particular effects, would argue him of want of skill and providence, in the first laying of the foundations of his designed machine: he were an improvident clockmaker, that should have cast his work so, as when it were wound up and going, it would require the masters hand at every houre to make the hammer strike upon the bell. Let us not then too familiarly, and irreverently ingage the Almighty Architect his immediate handy-work in every particular effect of nature; *Tale non est dignus vindice nodus.*

But let us take principles within our own kenning; and consider how a body hath of its own nature three dimensions; (as Mathematicians use to demonstrate;) and that the variety which we see of figures in bodies proceedeth out of the defect of some of these dimensions in proportion to the rest. As for example, that a thing be in the form of a square tablet; is, for that the cause which gave it length and breadth, could not also give it thicknesse in the same proportion: for had it been able to give profundity as well as the other two, it had made a cube instead of a tablet. In like manner, the forme of a lamine, or very long square is occasioned by some accident which hindereth the cause from giving breadth and thicknesse proportiona-

2.
That the severall figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrence of accidental causes.

tionable to the length. And so, other figures are made, by reason that their causes are some wayes bound to give more of some dimension to one part then to another.

As for example, when water falleth out of the skie, it hath all the little corners or extancies of its body grated off by the aire as it rolleth and tumbleth down in it, so that it becometh round; and continueth in that form, untill that settling upon some flat body, as grasse or a leaf, it receiveth a little plainnesse, to the proportion of its weight mastering the continuitie of it. And therefore, if the drop be great upon that plain body, it seemeth to be half a sphere, or some lesse portion of one: but if it be a little drop then the flat part of it (which is that next unto the grasse) is very little and undiscernable, because it hath not weight enough to presse it much and spread it broad upon the grasse; and so the whole seemeth in a manner to be a sphere: but if the extern causes had pressed upon this drop, onely broadwayes and thickwayes (as when a turner maketh a round pillar of a square one) then it would have proved a cylinder, nothing working upon it to grate off any of its length, but onely the corners of the breadth and thicknesse of it.

And thus you see, how the fundamentall figures (upon which all the rest are grounded) are contrived by nature; nor by the work of any particular Agent that immediately imprineth a determinate figure into a particular body, as though it wrought it there at once, according to a foreconceived designe or intelligent aime of producing such a figure in such a body: but by the concurrence of severall accidentall causes, that do all of them joyn in bringing the body they file and work upon, into such a shape.

Onely we had like to have forgotten the reason and cause of the concave figure in some parts of plants: which in the ordinary course of nature we shall find to grow from hence, that a round outside being filled with some liquor which maketh it grow higher and higher, it happeneth that the succeeding causes do contract this liquor, and do harden the outside: and then of necessity there must be a hollow cylinder remaining in lieu of the juice which before did fill it. As we see every day in corn,
and

and in reeds, and in canes, and in the stalks of many herbs : which whilst they are tender and in their first groweth, are full of juice, and become afterwards hollow and dry.

But because this discourse, may peradventure seem too much in common : it will not be amiss to apply it to some particulars that seem very strange. And first, let us examine how the rocking of concrete juices (which seemeth to be such an admirable mystery of nature) is performed. Allom falleth down in lumps, saltpeter in long icicles, and common salt in squares ; and this, not once, or sometimes now and then ; but alwayes constantly in the same order.

The reason of these effects will easily be deduced out of what we have said, for if all three be dissolved in the same water, allom being the grossest falleth first and fastest : and being of an unctious nature, the first part which falleth doth not harden till the second cometh to it ; whereby this second sticketh to the first and crusheth it down, and this is served in the same manner by the third ; and so goeth on, one part squeezing another, till what is undermost grow hard enough to resist the weight of new falling parts ; or rather till no more do fall, but the liquor they were dissolved in, is delivered of them all, and then they harden in that figure they were compressed into.

As for salt, which descendeth in the second place : that swimmeth first upon the water ; and there, getteth its figure, which must be equally long and broad, because the water is indifferent to those two positions ; but its thicknesse is not equall to its other two dimensions, by reason that before it can attain to that thicknesse, it groweth too heavie to swimme any longer ; and after it is encreased to a certain bulk, the weight of it carrieth it down to the bottome of the water, and consequently, it can encrease no more : for it encreaseth by the joyning of little parts unto it as it swimmeth on the toppe of the water.

The saltpeter falleth last : which being more difficult to be figured then the other two, because it is more dry then either of them (as consistting chiefly of earthy and of fiery parts,) is not equally encreased, neither in all three, nor in two dimensions, but hath its length exceeding both its breadth and thicknesse :

and.

3.
The former doctrine is confirmed by several instances.

and its lightnesse maketh it fall last, because it requireth least water to sustain it.

To give the causes of the figures of divers mixts, and particularly of some pretious stones, (which seem to be cast by nature in exactest moulds) would oblige us to enter into the particular manner of their generation : which were exceeding hard, if not impossible, for us to do, by reason that Authours have not left us the circumstances upon which we might ground our judgement concerning them, so particularly described as were necessary ; nor our selves have met with the commodity of making such experiences, and of searching so into their beds as were requisite, to determine solidely the reasons of them. And indeed I conceive that oftentimes the relations which others have recorded of their generation, would rather misseleade then assist us : since it is very familiar in many men, to magnifie the exactnesse of nature in framing effects they phansie to themselves, when to make their wonder appear more just ; they will not fail to set off their story, with all advantagious circumstances, and help out what wanteth a little or cometh but near the mark.

4.
The same doctrine applied to Plants.

But to come closer to our purpose ; that is, to the figures of living things : we see that roots in the earth are all of them figured almost in the same fashion : for the heat residing in the midst of them, pusheth every way ; and thereupon, some of them do become round, but others more long then round, according to the temper of the ground, or to the season of the year, or to the weather that happeneth : and this, not onely in divers kinds of roots, but even in severall of the same kind. That part of the plant which mounteth upwards is for the most part round and long ; the cause whereof is evident, for the juice which is in the middle of it working upwards (because the hardnesse of the bark will not let it out at the sides) and coming in more and more abundance (for the reasons we have above delivered) encreaseth that part equally every way but upwards ; and therefore, it must be equally thick and broad, and consequently round : but the length will exceed either of the other dimensions ; because the juice is driven up with a greater force and in more quantity then it is to the sides. Yee the

the broadnesse and thickenesse are not so exactly uniform, but that they exceed a little more at the bottom then at the toppe; which is occasioned partly by the contracting of the juice into a narrower circuit the further it is from the source; and partly by reason of the branches; which shooting forth, do convey away a great part of the juice from the main stock.

Now if we consider the matter well; we shall find, that what is done in the whole tree the very same is likewise done in every little leaf of it: for a leaf consisteth of little branches shooting out from one greater branch, which is in the middle; and again, other lesser branches are derived from those second branches: and so still lesser and lesser, till they weave themselves into a close work, as thick as that which we see women use to fill up with silk or crewell, when in tentwork they embroider leaves or flowers upon canvas: and this again, is covered and as it were glewed over, by the humour which sticking to these little thriddes, stoppeth up every little vacuity, and by the ayre is hardned into such a skinne as we see a leaf consisteth of.

And thus it appeareth how an account may be given of the figure of the leafs, as well as of the figure of the main body of the whole tree: the little branches of the leaf, being proportionate in figure to the branches of the tree it self (so that each leaf seemeth to be the tree in little;) and the figure of the leaf depending of the course of these little branches, so that if the greatest branch of the tree be much longer then the others, the leaf will be a long one: but if the lesser branches spread broadways, the leaf will likewise be a broad one; so farre, as even to be notched at the outsides, round about it, in great or little notches, according to the proportion of the trees branches. These leafs, when they first break out are foulded inwards, in such sort as the smalnesse and roundnesse of the passage in the wood through which they issue, constraineth them to be: where neverthelesse the driness of their parts keep them asunder, so that one leaf doth not incorporate it self with another: but as soon as they feell the heat of the sunne (after they are broken out into liberty) their tender branches by little and little
grow.

5.
The same doctrine declared
in leafs of trees

grow more straight : the concave parts of them drawing more towards the sunne, because he extracteth and sucketh their moisture from their hinder parts into their former, that are more exposed to his beams ; and thereby the hinder parts are contracted and grow shorter, and those before grow longer. Which if it be in excessse, maketh the leaf become crooked the contrary way, as we see in divers flowers, and in sundery leaves during the summers heat : witnesse, the Ivie, Roses full blown, Tulips, and all flowers in form of bells : and indeed all kinds of flowers whatsoever, when the sunne hath wrought upon them to that degree we speak of, and that their joyning to their stalk, and the next parts thereunto, allow them scope to obey the impulse of those outward causes. And when any do vary from this rule, we shall as plainly see other manifest causes producing those different effects, as now we do these working in this manner.

As for fruits though we see that when they grow at liberty upon the tree, they seem to have a particular figure allotted them by nature : yet in truth, it is the ordered series of naturall causes and not an intrinsecall formative virtue which breedeth this effect, as is evident by the great power which art hath to change their figures at pleasure : whereof you may see examples enough in Campanella, and every curious gardner can furnish you with store.

6. Out of these, and such like principles a man that would make it his study with lesse trouble or tediousnesse, then that patient contemplator of one of natures little works (the Bees) whom we mentioned a while ago, might without all doubt trace the causes in the growing of an Embryon, till he discovered the reason of every bones figure ; of every notable hole or passage that is in them : of the ligaments by which they are tied together : of the membranes that cover them, and of all the other parts of the body. How, out of a first masse, that was soft, and had no such parts distinguishable in it, every one of them came to be formed, by contracting that masse in one place, by dilating it in another, by moistning it in a third, by drying it here, hardening it there :

The same applied to the bodies of Animals

— *Ut his exordia primis,*

Omnia, & ipse tener hominis concreverit orbis.

till in the end this admirable machine and frame of mans body, was composed and fashioned up by such little and almost insensible steps and degrees. Which when it is looked upon in bulk, and entirely formed, seemeth impossible to have been made, and to have sprung merely out of these principles, without an Intelligence immediately working and moulding it at every turn, from the beginning to the end.

But withall, we cannot chuse but break out into an extasie of admiration and hymnes of praise (as great Galen did upon the like occasion) when we reverently consider the infinite wisdom, and deep farre-looking providence of the all-seeing Creatour and orderer of the world, in so punctually adapting such a multitude and swarm of causes to produce by so long a progresse so wonderfull an effect: in the whole course of which, if any one, the very least of them all, went never so little awry, the whole fabrick would be discomposed and changed from the nature it is designed unto.

Out of our short survey of which (answerable to our weak talents, and slender experience) I perswade my self it appeareth evident enough, that to effect this worke of generation, there needeth not be supposed a forming virtue or *Vis formatrix* of an unknown power and operation, as those that consider things suddenly and but in grosse, do use to put. Yet in discourse, for conveniency and shortnesse of expression we shall not quite banish that terme from all commerce with us; so that what we mean by it be rightly understood, which is the complex assemblment, or chain of all the causes, that concur to produce this effect, as they are set on foot to this end by the great Architect and Moderatour of them, God Almighty, whose instrument Nature is: that is, the same thing, or rather the same things so ordered as we have declared, but expressed and comprised under another name.

7.

In what sense
the Authour
doth admit of
Vis formatrix.

CHAP. XXVI.

How motion beginneth in living creatures. And of the motion of the heart; circulation of the blood; Nutrition, Augmentation, and corruption or death.

I.
From whence doth proceed the primary motion and growth in plants.

BUT we must not take our leave of this subject, untill we have examined, how motion beginneth in living things; as well plants as sensitive creatures. We can readily pitch upon the part we are to make our observations in, for retrieving the origine of this primary motion: for having concluded that the roots of plants, and the hearts of animals are the parts of them which are first made, and from which the forming virtue is derived to all the rest, it were unreasonable to seek for their first motion any where else.

But in what manner, and by what means, doth it beginne there? for roots, the difficulty is not great: for the moysture of the earth pressing upon the seed, and soaking into it; the hot parts of it which were imprisoned in cold and dry ones, are thereby stirred up and set on work: then they mingling themselves with that moysture, do ferment and distend the whole seed; till making it open, and break the skinne more juice cometh in: which incorporating it selfe with the heat, those hot and now moyst parts will not be contained in so narrow a roomie as at the first; but struggling to get out on all sides, and striving to enlarge themselves, they thrust forth little parts: which, if they stay in the earth, do grow white and make the root; but those which ascend, and make their way into the aire, being lesse compressed, and more full of heat and moysture, do turn green: and as fast as they grow up, new moysture coming to the roots, is sent up through the pores of it: and this faileth not, untill the heat of the root it self doth fail. For it being the nature of heat to rarifie and elevate, there must of necessity be caused in the earth a kind of sucking in of moysture into the root from the next parts unto it to fill those capacities which the dilating heat hath made that else

else would be empty, and to supply the roomes of those which the heat continually sendeth upwards: for the moysture of the root hath a continuity with that in the earth, and therefore, they adhere together (as in a pump, or rather as in filtration) and do follow one another when any of them are in motion, and still the next must needs come in, and fill the roomes, where it findeth an empty space immediate to it. The like of which happeneth to the aire when we breathe: for our lungs being like a bladder, when we open them, the aire must needs come in, to fill that capacity which else would be emptie: and when we shut them again; as in a pair of bellows we put it out.

This may suffice, concerning the primary motion of roots: but in that of the heart; we shall find the matter not altogether so plain, Monsieur des Cartes following herein the steps of the learned and ingenuous Doctour Harvey, who hath invented and teacheth that curious and excellent doctrine of the circulation of the blood; (as indeed, what secret of nature can be hidden from so sharp a wit, when he applyeth himself to penetrate into the bottome of it;) explicateth the matter much after this sort. That the heart, within, in the substance of it, is like a hollow cavern; in whose bottome, were an hot stone; on which should drop as much liquour as the fiery stone could blow into smoke; and this smoke or steam should be more then the cave could contain; wherefore it must break out; which to do, it presseth on all sides to get an issue or doore to let it out: it findeth of two sorts, but onely one kind of them will serve it for this purpose; for the one sort of these doores, openeth inwards, the other outwards: which is the cause that the more it striveth to get out, the faster it shutteth the doores of the first kind; but by the same means, it beateth back the other doores, and so getteth out.

Now when it is gone quite out of this cavern, and consequently leaveth it to its naturall disposition; whereas, before it violently stretched it out; and by doing so kept close the doores that open inwards: then all the parts of it begin to slacken; and those doores give way unto new liquour to drop in anew; which the heat in the bottome of the heart, rarifieth again

2.
Monsieur des
Cartes his opi-
nion touching
the motion of
the heart.

into smoke as before. And thus he conceiveth the motion of the heart to be made, taking the substance of it to be (as I may say) like unto limber leather, which upon the filling of it with blood and steam, openeth and dilateth it self: and at the going of it out, it shrinketh together like a bladder.

3.
The former opinion rejected.

But I doubt, this explication will not go through the difficulty: for first, both Galen and Doctour Harvey do shew, that as soon as the blood is come into the heart, it contracteth it self: which agreeth not with Monsieur des Cartes his supposition: for in his doctrine, there appeareth no cause why it should contract it self when it is full: but contrariwise, it should go on dilating it self, untill enough of the blood which drop-peth into the heart, were converted into steam, to force the doores open; that so, it may gain an issue thence, and a passage into the body.

Next, Monsieur des Cartes supposeth that the substance of the heart is like a bladder, which hath no motion of it self, but openeth and shutteth, according as what is within it stretcheth it out, or permitteth it to shrink and fall together again. Whereas Doctour Harvey proveth that when it is full, it compresseth it self by a quick and strong motion, to expell that which is in it; and that when it is empty, it returneth to its naturall dilatation, figure and situation, by the ceasing of that agents working, which caused its motion. Whereby it appeareth to be of such a fibrous substance, as hath a proper motion of its own.

Thirdly, I see not how this motion can be proportionall: for the heart must needs open and be dilated, much faster then, it can be shut and shrink together: there being no cause put to shut it and to bring it to its utmost period of shrinking, other then the going out of the vapour, whereby it becometh empty: which vapour not being forced by any thing but by its own inclination, it may peradventure at the first when there is abundance of it, swell and stretch the heart forcibly out; but after the first impulse and breach of some part of it out of the caverne that enclosed it, there is nothing to drive out the rest, which must therefore steam very leisurely out.

Fourth-

Fourthly, what should hinder the blood from coming in, before the heart be quite empty and shrunk to its lowest pitch? For as soon as the vapour yieldeth within, new blood may fall in from without; and so keep the heart continually dilated, without ever suffering it to be perfectly and completely shut.

Fifthly, the heart of a viper layed upon a plate in a warm place will beat foure and twenty houres, and much longer, if it be carefully taken out of its body, and the weather be warm and moyst: and it is clear, that this is without succession of blood to cause the pulses of it. Likewise, the severed members of living creatures will stirre for some time after they are parted from their bodies: and in them, we can suspect no such cause of motion.

Sixthly, in Monsieur des Cartes his opinion, the heart should be hardest when it is fullest; and the eruption of the steam out of it, should be strongest at the beginning, whereas experience sheweth; that it is softest when it is at the point of being full, and hardest when it is at the point of being empty; and the motion strongest, towards the end.

Seventhly, in Monsieur des Cartes his way, there is no agent or force strong enough to make blood gush out of the heart: for if it be the steam onely that openeth the doores, nothing but it will go out; and the blood will still remain behind, since it lieth lower then the steam, and further from the issue that letteth it out: but Doctor Harvey findeth by experience (and teacheth how to make this experience) that when a wound is made in the heart, blood will gush out by spurts at every shooting of the heart.

And lastly, if Monsieur des Cartes his supposition were true, the arteries would receive nothing but steams; whereas it is evident that the chief filler of them is blood.

Therefore we must enquire after another cause of this primary motion of a sensitive creature, in the beatings of its heart. Wherein we shall not be obliged to look farre: for seeing we find this motion and these pulsations in the heart when it is separated from the body, we may boldly and safely conclude, that it must of necessity be caused by something that is

4.
The Authours
opinion con-
cerning the mo-
tion of the heart

within the heart it self. And what can that be else, but heat or spirits imprisoned in a tough viscusous blood; which it cannot so presently break through to get out; and yet can stirre within it, and lift it up?

The like of which motion may be observed, in the heaving up, and sinking down again of loose mould thrown into a pit, into which much ordure hath been emptied. The same cause, of heat in the earth, maketh mountains and sands to be cast up in the very sea: so, in frying, when the pan is full of meat, the bubbles rise and fall at the edges: treacle, and such strong compounded substances; whiles they ferment, do lift themselves up and sink down again, after the same manner as the vipers heart doth: as also do the bubbles of barm, and must of wine: and short ends of lute strings baked in a juicy pie, will at the opening of it move in such sort, as they who are ignorant of the feat will think there are magots in it: and a hot loaf, in which quicksilver is enclosed, will not onely move thus, but will also leap about, and skip from one place to another, like the head or limbe of an animall (very full of spirits) newly cut off from its whole body.

And that this is the true cause of the hearts motion, appeareth evidently. First, because this virtue of moving is in every part of the heart, as you will plainly see if you cut into severall pieces a heart, that conserveth its motion long after it is out of the animals belly: for every piece will move; as Doctor Harvey assureth us by experience, and I my self have often seen, upon occasion of making the great antidote, in which vipers hearts is a principall ingredient. Secondly, the same is seen in the auricles and the rest of the heart; whose motions are severall; though so near together, that they can hardly be distinguished. Thirdly, Doctor Harvey seemeth to affirm that the blood which is in the ears of the heart, hath such a motion of it self, precedent to the motion of the ears it is in: and that this virtue remaineth in it for a little space after the ears are dead. Fourthly, in touching a heart which had newly left moving, with his finger wetted with warm spittle it began to move again, as testifying that heat and moisture made this motion. Fifthly, if you touch the vipers heart over with vineger, with

with spirit of wine, with sharp white wine, or with any piercing liquor; it presently dyeth: for the acutenesse of such substances pierceth through the viscuous blood, and maketh way for the heat to get out.

But this first mover of an animall, must have something from without to stirre it up; else, the heat would lie in it, as if it were dead; and in time would become absolutely so. In egges, you see this exterior mover, is the warmth of the henne hatching them. And in Embryons, it is the warmth of the mothers wombe. But when in either of them, the heart is completely formed, and is enclosed in the breast; much heat is likewise enclosed there, in all the parts near about the heart; partly made by the heart it self, and partly caused by the outward heat, which helped also to make that in the heart: and then although the warmth of the hen or of the mothers womb, do forsake the heart; yet this stirreth up the native heat within the heart and keepeth it in motion, and maketh it feed still upon new sewell, as fast as that which it worketh upon decayeth.

But to expresse more particularly how this motion is effected; we are to note, that the heart hath in the ventricles of it three sorts of fibers: the first go long wayes or are straight ones, on the sides of the ventricles from the thick basis of the heart, towards the little tip or cone of it: the second, go crosse or round-ways about the ventricles within the heart: and the third, are transversall or thwart ones. Next, we are to remember, that the heart is fixed to the body by its base; and hangeth loose at the cone. Now then, the fibers being of the nature of such things as will swell and grow thicker by being moistened, and consequently shrink up in length and grow shorter in proportion to their swelling thicker (as you may observe in a loose wrought hempen rope) it must of necessity follow, that when the blood falleth into the heart (which is of a kind of spongie substance) the fibers being therewith moistened, they will presently swell in roundnesse and shrink in length.

Next, we are to note, that there is a double motion in the heart: the one of opening, which is called, Diastole; the other of shutting, which is termed Systole. And although Doctour Harvey seemeth to allow the opening of the heart to be no motion;

5.
The motion of the heart dependeth originally of its fibers irrigated by blood.

but rather a relenting from motion; nevertheless (me thinketh) it is manifest, that it is not onely a compleat motion; but in a manner the greater motion of the two, though indeed the lesse sensible; because it is performed by little and little; for in it the heart is drawn by violence from its naturall position; which must be (as it is of all heavy things) that by which it approacheth most to the center of gravity; and such a position we see it gaineth by the shutting of it.

Now to declare how both these motions are effected, we are to consider how at the end of the systole the heart is voided and cleansed of all the blood that was in it; whence it followeth, that the weight of the blood which is in the auricles, pressing upon the *valvulas* or doores that open inwards, waketh its way by little and little into the ventricles of the heart, where it must necessarily swell the fibers; and they being swelled must needs draw the heart into a roundish and capacious figure, which the more it is done, the more blood cometh in, and with greater violence. The following effect of which must be, that the weight of the blood joynd to the weight of the heart it self, and particularly of the *conus* or tip (which is more solid and heaive in proportion to its quantity, then the rest of the heart) must necessarily set the heart into the natural motion of descending according to its gravity: the which consequently, is performed by a lively jerck, whereby it cometh to passe that the tip of our heart doth as it were spring up towards our breast: & the blood is spurted out by other *valvulae* (that open outwards) which are aptly disposed to be opened upon such a motion, & do convey it to the arteries.

In the course of which motion, we may note how the figure of our heart contributeth to its springing up towards our breast; for the line of distance which is between the basis & the tip being longer on that side which is towards the back, then on the other which is towards the breast, it must happen that when the heart shutteth and straighteneth it self, and thereby extendeth it self to its length, the tip will butte out forwards towards the breast.

6. Against this doctrine of the motion, and of the systole and diastole of the heart, it may be objected, that beasts hearts do not hang like a mans heart, straight downwards; but rather horizontally; and therefore this motion of gravity cannot have place.

place in them: nevertheless, we are sure they beat, and do open and shut regularly. Besides, if there were no other cause but this of gravity for the motion of a mans heart, it would follow that one who were set upon his head or hung by his heels, could not have the motion of his heart: which posture nevertheless, we see men remain in for a pretty while, without any extreme prejudice.

But these difficulties are easily answered; for whether beasts hearts do lie directly horizontally, or whether the basis be fastened somewhat higher then the tip reacheth, and so maketh their heart hang inclining downwards; still the motion of gravity hath its effect in them. As we may perceive in the heart of a viper lying upon a plate, and in any other thing that of it self swelleth up, and straight again sinketh down: in which we cannot doubt, but that the gravity fighting against the heat, maketh the elevated parts to fall, as the heat maketh them rise.

And as for the latter; it is evident that men cannot stay long in that posture without violent accidents; and in any little while we see that the blood cometh into their face and other parts which naturally are situated higher; but by this position become lower then the heart: and much time is not required, to have them quite disordered and suffocated; the blood passing through the heart with too much quicknesse, and not receiving due concoction there; and falling thence in too great abundance into places that cannot with conveniency entertain it.

But you will insist, and ask, whether in that posture the heart doth move or no, and how? And to speak by guesse in a thing I have not yet made experiences enough to be thoroughly informed in; I conceive without any great scruple that it doth move. And that it happeneth thus; that the heart hanging somewhat loose, must needs tumble over, and the tip of it lean downwards some way or other; and so lie in part like the heart of a beast; though not so conveniently accommodated: and then the heat which maketh the viscuous blood that is in the substance of the heart to ferment will not fail of raising it up; whereupon the weight of that side of the heart that is lifted up, wil presently presse it down again. And thus, by the alternative operations of these causes,

causes, the heart will be made to open and shut it self, as much as is necessary for admitting and thrusting out, that little and disorderly coming blood, which maketh its course through it, for that little space wherein the man continueth in that position.

7.
The circulation
of the blood, &
other effects
that follow the
motion of the
heart.

Now from these effects wrought in the heart by the moistening of the fibers, two other effects do proceed: the one is, that the blood is pushed out of every corner of the heart with an impetuoussness or velocity. The other is, that by this motion the spirits which are in the ventricles of the heart, and in the blood that is even then heated there, are more and deeper pressed into the substance of the heart, so that you see the heart imbibeth fresh vigour, and is strengthened with new spirits, whiles it seemeth to reject that which should strengthen it.

Again, two other effects follow this violent ejection of the blood out of the heart. The one is, that for the present the heart is entirely cleansed of all remainders of blood, none being permitted to fall back to annoy it. The other is, that the heart finding it self dry, the fibers do relent presently into their naturall position and extension, and the valvulæ that open inwards, fall flat to the sides of the ventricles, and consequently new blood droppeth in. So that in conclusion, we see the motion of the heart dependeth originally of its fibers irrigated by the blood, and not from the force of the vapour, as Monsieur des Cartes supposeth.

This motion of the heart driveth the blood (which is warmed and spiritualized, by being boyled in this furnace) through due passages into the arteries, which from them runneth into the veins, and is a main cause of making and nourishing other parts; as the liver, the lungs, the brains, and whatsoever else dependeth of those veins and arteries through which the blood goeth. Which being ever freshly heated, and receiving the tincture of the hearts nature, by passing through the heart, where-soever it stayeth and curdleth, it groweth into a substance of a nature conformable to the heart, though every one of such substances be of exceeding different conditions in themselves, the very grossest excrements not being excluded from some participation of that nature.

But

But if you desire to follow the blood all along every step in its progresse from the heart round about the body, till it return back again to its center, Doctour Harvey who most acutely teacheth this doctrine, must be your guide. He will shew you how it issueth from the heart by the arteries, from whence it goeth on warming the flesh, untill it arrive to some of the extremities of the body : and by then it is grown so cool (by long absence from the fountain of its heat ; and by evaporating its own flock of spirits, without any new supply) that it hath need of being warmed anew ; it findeth it self returned back again to the heart, and is there heated again, which return is made by the veins , as its going forwards is performed onely by the arteries.

And were it not for this continuall circulation of the blood, and this new heating it in its proper caldron, the heart ; it could not be avoided but that the extreme parts of the body would soon grow cold and die. For flesh being of it self of a cold nature (as is apparent in dead flesh) and being kept warm, merely by the blood that bedeweth it ; and the blood likewise being of a nature that soon groweth cold and congealeth , unlesse it be preserved in due temper by actuall heat working upon it : how can we imagine that they two singly, without any other assistance ; should keep one another warm (especially in those parts that are farre distant from the heart) by onely being together ? Surely we must allow the blood , (which is a substance fit for motion) to have recourse back to the heart, (where onely it can be supplied with new heat and spirits) and from thence be driven out again by its pulses or strokes, which are his shuttings. And as fast as it flieth out, (like a reeking thick steam, which riseth from perfumed water falling upon a heated pan) that which is next before it must flie yet further on, to make way for it ; and new arteriall blood still issuing forth at every pulse, it must still drive on what issued thence the last precedent pulse, and that part must presse on what is next before it. And thus it fareth with the whole masse of blood, which having no other course but in the body, it must at length run round, and by new vessels (which are the veins) return back unto the place from whence it issued first : and by that time it cometh thither, it is grown cool and thick, and needeth a vigorous restauration of spirits.

spirits and a new rarifying; that then it may warm the flesh it passeth again through; without which it would suddenly grow stone cold, as is manifest if by tying or cutting the arteries, you intercept the blood which is to nourish any part: for then that part groweth presently cold and benumbed.

8.
Of Nutrition.

But referring the particulars of this doctrine unto Doctour Harvey (who hath both invented and perfected it) our task in hand calleth upon us to declare in common the residue of motions that all living creatures agree in. How generation is performed we have determined in the past discourse. Our next consideration then ought to be of Nutrition and Augmentation. Between which there is very little difference in the nature of their action; and the difference of their names is grounded more upon the different result in the period of them, then upon the thing it self; as will by and by appear. Thus then is the progresse of this matter: as soon as a living creature is formed, it endeavoureth straight to augment it self; and employeth it self onely about that; the parts of it being yet too young and tender to perform the other functions which nature hath produced them for. That is to say; the living creature, at its first production, is in such a state and condition as it is able to do nothing else; but (by means of the great heat that is in it) to turn into its own substance the abundance of moysture that overfloweth it.

They who are curious in this matter, do tell us that the performance of this work consisteth in five actions; which they call Attraction, Adhesion, Concoction, Assimilation, and Union. The nature of attraction we have already declared when we explicated how the heart and the root sendeth juyce into the other parts of the animal or plant: for they abounding in themselves with inward heat, and besides that, much other circumstant heat working likewise upon them; it cannot be otherwise, but that they must needs suck and draw into them, the moysture that is about them,

As for adhesion, the nature of that is likewise explicated, when we shewed how such parts as are moist but especially aereall or oily ones (such as are made by the operation of a soft and continuall heat) are catching and do easily stick unto any body

body they happen to touch: and how a little part of moyſture between two dry parts, joyneth them together. Upon which occasion, it is to be noted that parts of the ſame kind do joyn beſt together: and therefore the powder of glaſſe is uſed to ciment broken glaſſe withall (as we have touched ſomewhere above:) and the powder of marble to ciment marble with; and ſo of other bodies: in like manner, Alchymiſts find no better expedient to extract a ſmall proportion of ſilver mixed with a great one of gold, then to put more ſilver to it: nor any more effectually way to get out the heart, or tincture, or ſpirits of any thing they diſtill or make an extract of, then to infuſe its own ſlegme upon it, and to water it with that. Now whether the reaſon of this be, that continuity, becauſe it is an unity, muſt be firmeſt between parts that are moſt conformable to one another, and conſequently are moſt one among themſelves; or whether it be for ſome other hidden cauſe, belongeth not to this place to diſcourſe: but in fine ſo it is. And the adheſion is ſtrongeſt of ſuch parts as are moſt conformable to that which needeth enereaſe and nourishment; and that is made up by the other three actions.

Of which, concoction is nothing elſe but a thickning of that juyce which already ſticketh to any part of the animals body, by the good digeſtion that heat maketh in it. And aſſimilation is the effect of concoction: for this juyce being uſed in the ſame manner, as the firſt juyce was that made the part whereunto this is to be joyned; it cannot chooſe but become like unto it in ſubſtance. And then, there being no other ſubſtance between, it is of it ſelf united unto it without any further help.

Hitherto this action belongeth to nutrition. But if on the one ſide, the heat and ſpirituality of the blood; and on the other ſide the due temper and diſpoſition of the part be ſuch, as the blood is greedily ſucked into the part, which thereby ſwelleth to make room for it, and will not let it go away, but turneth it into a like ſubſtance as it ſelf is; and in greater quantity then what is conſumed and decayeth continually by tranſpiration: then this action is called likewiſe augmentation. Which Galen explicateth by a ſport the boyes of Ionia uſed; who were accuſtomed to fill a bladder with wind; and when they could force no more into it, they would rub the bladder, and after rubbing of it, they

9.
Of Augmentat
tion.

found it capable of receiving new breath; and so they would proceed on, untill their bladder were as full as by use they knew it could be made. Now (saith he) nature doth the like, by filling our flesh and other parts with blood; that is to say, it stretcheth the fibers: but she hath over and above a power which the boyes had not; namely to make the fibers as strong after they are stretched to their utmost extension, as they were before they were extended: whence it happeneth that she can extend them again as well as at the first; and this without end, as far as concerneth that part.

The reason whereof is, because she extendeth them by means of a liquour which is of the same nature, as that whereof they were made at the first: and from thence it followeth, that by concoction that liquour settleth in the parts of the fibers which have most need; and so maketh those parts as great in the length they are extended unto, as they were in their shortnesse before they were drawn out. Whereby the whole part of the animal, wherein this happeneth, groweth greater: and the like being done in every part, as well as in any one single one, the whole animal becometh bigger; and is in such sort augmented.

IO.
Of death and
sicknesse.

Out of all which discourse, we may collect that in the essentiall composition of living creatures, there may peradventure be a physicall possibility for them to continue alwayes without decay; and so become immortall, even in their bodies, if all hurtfull accidents coming from without might be prevented. For seeing that a man, besides the encrease which he maketh of himself, can also impart unto his children a virtue, by which they are able to do the like. and to give again unto theirs as much as they received from their fathers: it is clear, that what maketh him die, is no more the want of any radicall power in him, to encrease or nourish himself; then in fire, it is the want of power to burn, which maketh it go out. But it must be some accidentall want, which Galen attributeth chiefly to the drinesse of our bones, and sinews, &c. as you may in him see more at large; for drinesse with density alloweth not easie admittance unto moysture: and therefore it causeth the heat which is in the dry body, either to evaporate, or to be extinguished: and want of heat is that from whence the failing of life proceedeth

eth: which he thinketh cannot be prevented by any art or industry.

And herein God hath expressed his great mercy and goodnesse towards us: for seeing that by the corruption of our own nature, we are so immersed in flesh and blood, as we should for ever delight to wallow in their mire, without raising our thoughts at any time above that low and brutall condition; he hath engaged us by a happy necessity, to think of and to provide for a nobler and farre more excellent state of living that will never change or end.

In pursuance of which inevitable ordinance, man (as if he were grown weary and out of love with this life, and scorned any term in his farm here, since he cannot purchase the see-simple of it) hasteneth on his death by his unwary and rash use of meats, which poyson his blood: and then his infected blood passing through his whole body, must needs in like manner taint it all at once. For the redresse of which mischief, the assistance of physick is made use of: and that passing likewise the same way, purifieth the blood, and recovereth the corruption occasioned by the peccant humour; or other whiles gathering it together, it thrusteth and carrieth out that evill guest, by the passages contrived by nature to disburden the body of unprofitable or hurtfull superfluities.

CHAP. XXVII.

Of the motions of sense; and of the sensible qualities in generall; and in particular, of those which belong to Touch, Taste, and Smelling.

HAVING thus brought on the course of nature as high as living creatures (whose chief specieses or division is those that have sense) and having declared the operations which are common to the whole tribe of them which includeth both plants and animals; it is now time we take a particular view of those, whose action and passion is the reason why that chief portion of life is termed sensitive; I mean the senses, and the qualities, by which the outward world cometh into the living creature through his senses. Which when we shall have gone through,

I.
The connexion of the subsequent chapters with the precedent.

we shall scarcely have left any qualities among bodies, to plead for a spirituall manner of being or working; that is, for a self-ctivity, and instantaneous operation: which kind of things and properties, vulgar Philosophy is very earnest to attribute unto our senses: with what reason, and upon what ground let us now consider.

2.
Of the senses &
sensible quali-
ties in generall.
And of the end
for which they
scrrc.

These qualities are reduced to five severall heads, answerable to so many different wayes, whereby we receive notice of the bodies that are without us. And accordingly, they constitute a like number of different senses: of every one of which, we will discourse particularly, when we have examined the natures of the qualities that affect them. But now, all the consideration we shall need to have of them, is onely this; That it is manifest the organes in us, by which sensible qualities do work upon us, are coporeall, and are made of the like ingredients as the rest of our body is; and therefore must of necessity be liable to suffer evil and to receive good (in such sort as all other bodies do) from those active qualities* which make and marre all things within the limits of nature. By which terms of Evill and Good, I mean those effects that are averse or conformable to the particular nature of any thing; and thereby do tend to the preservation or destruction of that individuall.

Now we receiving from our senses the knowledge that we have of things without us, do give names unto them according to the passions and affections which those things cause in our senses: which being the same in all mankind (as long as they are considered in common, and that their effects are looked upon in grosse) all the world agree in one notion, and in one name of the same thing; for every man living is affected by it, just as his neighbour is, and as all men else in the world are. As for example, heat or cold worketh the same feeling in every man composed of flesh and blood; and therefore whosoever should be asked of them would return the same answer, that they cause such and such effects in his sense, pleasing or displeasing to him, according to their degrees, and as they tend to the good or evill of his whole body.

But if we descend to particulars, we shall find that severall men of differing constitutions do frame different notions of the same

same

same things, according as they are conformable or disagreeing to their natures: and accordingly they give them different names. As when the same liquour is sweet to some mens taste, which to anothers appeareth bitter: one man taketh that for a perfume, which to another is an offensive smell: in the Turkish baths; (where there are many degrees of heat in divers rooms, through all which the same person useth to passe, and to stay a while in every one of them, both at his entrance and going out, to season his body by degrees, for the contrary excess he is going unto) that seemeth chilly cold at his return; which appeared melting hot at his going in; as I my self have often made experience in those countreys. Beauty and loveliness will shine to one man in the same face, that will give aversion to another. All which proclaimeth, that the sensible qualities of bodies are not any positive reall thing, consisting in an indivisible, and distinct from the body it self; but are merely the very body, as it affecteth our senses: which to discover how they do it, must be our labour here.

Let us therefore begin with considering the difference that is between sensible & insensible creatures. These latter do lie exposed to the mercy of all outward agents that from time to time (by the continuall motion which all things are in) do come within distance of working upon them: and they have no power to remove themselves from what is aversive to their nature; nor to approach nearer unto what comforteth it. But the others having within themselves a principle of motion (as we have already declared) whensoever such effects are wrought upon them, as upon the others; they are able upon their own account and by their own action, to remove themselves from what begetteth to annoy them, and to come nearer unto what they find a beginning of good by.

These impressions are made upon those parts of us, which we call the organs of our senses; and by them do give us seasonable advertisements and knowledges whereby we may govern and order to the best advantage, our little charge of a body, according to the tunc or warnings of change in the great circumstant body of the world, as far as it may concern ours. Which how it is done, and by what steps it proceedeth, shall be in the following discourse laid open.

Of this great machine that environeth us, we who are but a small parcell, are not immediately concerned in every part of it. It importeth not us for the conservation of our body, to have knowledge of other parts then such as are within the distance of working upon us: those onely within whose sphere of activity we are planted, can offend or advantage us: and of them some are near us, others further from us. Those that are next unto us, we discern (according as they are qualified) either by our touch, or by our tast, or by our smelling; which three senses do manifestly appear to consist in a mere gradation of more or lesse grosse; and their operations are levelled to the three elements that presse upon us, earth, water, and aire. By our other two senses (our hearing and our seeing) we have notice of things further off: and the agents which work upon them, are of a more refined nature.

3.
Of the sense of
touching: and
that both it &
its qualities are
bodies.

But we must treat of them all in particular: and that which we will begin with shall be the touch, as being the grossest of them, and that which converseth with none but the most materiall and massie objects. We see it dealeth with heave consistent bodies, and judgeth of them by conjunction unto them, and by immediate reception of something from them. And according to the divers impressions they make in it, it distinguisheth them by divers names; which (as we said of the qualities of mixed bodies) are generally reduced to certain pairs, as hot and cold, wet and dry, soft and hard, smooth and rough, thick and thinne, & some others of the like nature; which we needlesse to enumerate, since we pretend not to deliver the science of them, but onely to shew that they and their actions are all corporeall.

And this is sufficiently evident, by mere repeating but their very names: for it is plain by what we have already said, that they are nothing else but certain affections of quantity, arising out of different degrees of rarity and density compounded together. And it is manifest by experience, that our sense receiveth the very same impressions from them which another body doth: for our body or our sense will be heated by fire; and will also be burned by it, if the heat be too great as well as wood: it will be constipated by cold water, moystened by humide things, and dried by dry bodies, in the same manner as any other body
what-

whatsoever; likewise, it may in such sort as they, be wounded and have its continuity broken by hard things; be pleased and polished by those that are soft and smooth; be pressed by those that are thick and heavie; and be rubbed by those that are rugged, &c.

So that those masters who will teach us that the impressions upon sense are made by spirituall or spirit-like things or qualities, which they call intentionall specieses, must labour at two works: the one to make it appear that there are in nature such things as they would perswade us; the other, to prove that these materiall actions we speak of are not able to perform those effects, for which the senses are given unto living creatures. And untill they have done that, I conceive we should be much too blame to admit such things, as we neither have ground for in reason, nor can understand what they are. And therefore we must resolve to rest in this belief, which experience breedeth in us; that these bodies work upon our senses no other wayes then by a corporeall operation; and that such a one is sufficient for all the effects we see proceed from them: as in the processe of this discourse we shall more amply declare.

The element immediately next to earth in grossness, is water. And in it is the exercise of our tast, our mouth being perpetually wet within; by means of which moysture, our tongue receiveth into it some little parts of the substance which we chew in our teeth, and which passeth over it. You may observe how, if we take any herb or fruit, and having chopped or beaten it small, we then put it into a wooden dish of water and do squeeze it a little; the juyce communicating and mingling it self with the water, infecteth it with the tast of it self, and remaining a while in the bowl, sinketh by little and little into the very pores of the wood: as is manifest by its retaining a long time after the tast and smell of that herb. In like manner, nature hath taught us by chewing our meat, and by turning it into our mouthes and pressing it a little (that we may the more easily swallow it) to imbue our spittle with such little parts as easily diffuse themselves in water. And then our spittle being continue to the moysture which is within our tongue, (in such sort as we declared of the moysture of the earth that soaketh into the

4.
Of the tast and its qualities: that they are bodies.

root of a plant) and particularly in the sinews of it; must of necessity affect those little sensible strings with the qualities which these petty bodies, mixed every where with the moisture, are themselves imbued withall.

And if you ask what motions or qualities these be: Physicians (unto whom it belongeth most particularly to look into them) will tell you, that some dilate the tongue more, and some lesse; as if some of these little bodies had an aereall, and others a watry disposition: and these two they expresse by the names of sweet and fatty. That some do contract and draw the tongue together, as choaky and rough things do most; and next to them crabby and immature sharpnesse. That some do corrode and pierce the tongue, as salt and sowre things. That bitter things do search the outside of it, as if they swept it: and that other things do as it were prick it, as spices and hot drinks. Now all these are sensible materiall things, vvhich admit to be explicated clearly, by the varieties of rarity and density concurring to their compositions; and are so proportionable to such materiall instruments as vve cannot doubt but that they may be throughly declared by our former principles.

5.
That the smell
and its qualities
are reall bodies.

The next element above water is aire, vvhich our nostrills, being our instrument to suck in, vve cannot doubt but what affecteth a man by his nose, must come unto him in breath or aire. And as humidity receiveth grosser and weightier parts, so those which are more subtile and light, do rise up into the aire; and these we know attain unto this lightnesse by the commixtion of fire, which is hot and dry. And therefore we cannot doubt, but that the nature of smell is more or lesse tending to heat and drought: which is the cause that their commixtion with the brain, proveth comfortable unto it; because of its own disposition it is usually subject to be too moist and too cold.

Whether there be any immediate instrument of this sense, to receive the passion or effect, which by it other bodies make upon us; or whether the sense it self be nothing but a passage of these exhalations and little bodies unto the brain, fitly accommodated to discern what is good or hurtfull for it, and accordingly to move the body to admit or reject them, imparteth

not

not us at present to determine: let Physicians and Anatomists resolve that question, while it sufficeth us to understand that the operations of bodies by odours upon our sense, are performed by reall & solide parts of the whole substance; which are truly materiall, though very little bodies; and not by imaginary qualities.

And those bodies, when they proceed out of the same things that yield also tastive particles, (although without such materiall violence, & in a more subtile manner) must of necessity have in them the same nature, which those have that affect the tast; and they must both of them affect a man much alike, by his tast and by his smell: and so are very proportionate to one another; excepting in those properties which require more cold or liquidity then can well stand with the nature of a smell. And accordingly, the very names which men have imposed to expresse the affections of both, do many times agree: as favour, which is common both to the smell and to the tast; and sweet likewise: the strongest of which we see oftentimes do make themselves known as well by the one as by the other sense; and either of them in excessse will turn a mans stomach. And the Physicians that write of these senses find them very conformable: and therefore it happeneth that the losing of one of them, is the losse also of the other.

And experience teacheth us in all beasts, that the smell is given unto living creatures, to know what meats are good for them, and what are not. And accordingly we see them still smell for the most part at any unknown meat before they touch it; which seldome faileth of informing them rightly: nature having provided this remedy against the gluttony, which could not choose but follow the convenient disposition and temper of their parts and humours; through which they often swallow their meat greedily and suddenly, without expecting to try it first by their tast. Besides that, many meats are so strong, that their very tasting them after their usuall manner, would poison or at the least greatly annoy them: and therefore nature hath provided this sense to prevent their tast; which being far more subtile then their tast; the small atomes by which it is performed are not so very noxious to the health of the animal, as the other grosser atomes are.

6.

Of the conformity betwixt the two senses of smelling and tasting.

7.
The reason why the sense of smelling is not so perfect in man as in beasts: with a wonderfull history of a man who could wind a sent as well as any beast.

And doubtlesly, the like use men would make of this sense, had they not on the one side better means then it to know the qualities of meats: and therefore, this is not much reflected upon. And on the other side, were they not continually stufed and clogged with grosse vapours of steamy meats, which are dayly reeking from the table and their stomachs; and permit not purer atomes of bodies, to be discerned; which require cleare and uninfected organes to take notice of them. As we see it fare with dogges; who have not so true and sensible noses, when they are high fed, and lie in the kitchen amidst the steams of meat; as when they are kept in their kennell, with a more spare diet, fit for hunting.

One full example, this age affordeth us in this kind, of a man whose extremity of fear, wrought upon him to give us this experiment. He was born in some village of the countrey of Liege: and therefore among strangers, he is known by the name of John of Liege. I have been informed of this story by severall (whom I dare confidently beleve) that have had it from his own mouth, and have questioned him with great curiosity, particularly about it.

When he was a little boy, there being warres in the countrey (as that State is seldome without molestations from abroad, when they have no distempers at home, which is an unseparable effect of a countries situation upon the frontiers of powerfull neighbouring Princes that are at variance) the village of whence he was, had notice of some unruly scattered troups that were coming to pillage them: which made all the people of the village flee hastily with what they could carry with them, to hide themselves in the woods: which were spacious enough to afford them shelter, for they joyned upon the Forrest of Ardenne. There they lay, till some of their scouts brought them word, that the souldiers of whom they were in such apprehension, had fired their town and quitted it. Then all of them returned home, excepting this boy; who, it seemeth, being of a very timorous nature, had images of fear so strong in his phansie; that first, he ran further into the wood then any of the rest; and afterwards apprehended that every body he saw through the thickets, and every voice he heard was the souldiers: and so hid himself from
his

his parents that were in much distresse seeking him all about, and calling his name as loud as they could. When they had spent a day or two in vain, they returned home without him, and he lived many years in the woods, feeding upon roots, and wild fruits, and mast.

He said that after he had been some time in this wild habitation, he could by the smell judge of the tast of any thing that was to be eaten : and that he could at a great distance wind by his nose, where wholesome fruits or roots did grow. In this state he continued (still shunning men with as great fear as when he first ran away; so strong the impression was, and so little could his little reason master it) untill in a very sharp winter, that many beasts of the forrest perished for want of food; necessity brought him to so much confidence, that leaving the wild places of the forrest, remote from all peoples dwellings, he would in the evenings steal among cattle that were fothered; especially the swine, and among them, glean that which served to sustain wretchedly his miserable life. He could not do this so cunningly, but that returning often to it, he was upon a time espied: and they who saw a beast of so strange a shape (for such they took him to be, he being naked and all overgrown with hair) believing him to be a satyre, or some such prodigious creature as the recounters of rare accidents tell us of; laid wait to apprehend him. But he that winded them as farre off, as any beast could do, still avoided them, till at the length, they laid snares for him, and took the wind so advantagiously of him, that they caught him : and then, soon perceived he was a man; though he had quite forgotten the use of all language : but by his gestures and cries, he expressed the greatest affrightedness that might be. Which afterwards he said (when he had learned anew to speak) was because he thought, those were the souldiers he had hidden himself to avoid, when he first betook himself to the wood ; and were alwayes lively in his phansie, through his fears continually reducing them thicher.

This man within a little while after he came to good keeping and full feeding, quite lost that acutenesse of smelling which formerly governed him in his taste; and grew to be in that particular as other ordinary men were. But at his first living with
other

other people, a woman that had compassion of him to see a man so near like a beast; and that had no language to call for what he wished or needed to have; took particular care of him; and was always very solicitous to see him furnished with what he wanted; which made him so apply himself unto her in all his occurrents, that whensoever he stood in need of ought, if she were out of the way, and were gone abroad into the fields, or to any other village near by, he would hunt her out presently by his sent, in such sort as with us those dogs use to do which are taught to draw dry foot. I imagine he is yet alive to tell a better story of himself than I have done; and to confirm what I have here said of him: for I have from them who saw him but few years ago, that he was an able strong man, and likely to last yet a good while longer.

And of another man, I can speak assuredly my self, who being of a very temperate or rather spare diet, could likewise perfectly discern by his smell the qualities of whatsoever was afterwards to passe the examination of his taste, even to his bread and bear. Wherefore to conclude, it is evident both by reason, and by experience, that the objects of our touch, our taste, and our smell, are materiall and corporeall things, derived from the division of quantity, into more rare and more dense parts; and may with ease be resolved into their heads and springs sufficiently to content any judicious and rationall man. Who if he be curious to have further satisfaction in this particular (as farre as concerneth odours and savours) may look over what Joannes Bravus (that judicious, though unpolished Physitian of Salamanca) hath written thereof.

THE EIGHT AND TWENTIETH CHAPTER.

Of the sense of hearing, and of the sensible quality sound.

BUt to proceed with the rest of the senses: because nature saw that some things came suddenly upon a living creature; which might do it hurt, if they were not perceived afar off: and that other things were placed at distance from it, which would greatly helpe it, if it could come neere unto them; she found a meanes to give us two senses more, for the discovery of remote things. The one principally and particularly to descry their motion. The other to marke their bulke and situation.

And so to begin with the former of these; we must needs acknowledge (after due examination of the matter) that the thing which we call sound is purely motion. And if it be objected that many motions are made without any discernable sound: We shall not make difficulty to grant it; considering that many motions die, before they come to touch the eare; or else are so weake, that they are drowned by other stronger motions, which round about besiege our eares in such manner, that notice is not taken of these: for so it fareth in what dependeth meeerly of quantity, especially, concerning our senses, that not every thing of the kind, but a terminate quantity or multitude of parts of it, maketh an object sensible.

But to come close to the point; we see that sound, for the most part, is made in the ayre; and that to produce it, there is required a quicke and smart motion of that Element, which, of all the rest, is the most moveable. And in motion, velocity or quicknesse, is proportionate to density in magnitude (as we have at large declared.) Which maketh quantity become perceptible in bulke, as this doth in motion. And as the one consisteth in a greater proportion of substance to the same quantity; so the other doth in the passage of more parts of the medium in the same time.

And in the moderating of this, such of the liberall Arts are employed, which belong to the cultivating mans voyce; as Rhetoricke, meetering, and singing. It is admirable how finely Galileo

Of the sense of hearing, and that sound is purely motion.

2.
Of divers arts
belonging to
the sense of
hearing: all
which confirm
that sound is
nothing but
motion.

to be heard
by the
ear
in a
vacuum

lileo hath delivered us the consonances of Musicke towards the end of his first Dialogue of motion; from the 95 page forward on: and how he hath shewed that matter cleerely unto the sight (so making the eye, as well as the eare judge of it) in motions of the water, in pendants hanging loose in the ayre, and in permanent notes or races made upon lutton. To the moderation of the same, many other mechanickall Arts are applied; as the trade of bellfounders; and of all makers of musickall instruments by wind, or by water, or by strings.

Neither can I slip over without mentioning the two curious arts of Echoing and of Whispering. The first of which, teacheth to iterate voyces severall times; and is frequently put in practise by those that are delighted with rarities in their gardens: And the other, sheweth how to gather into a narrow roome the motions of the ayre, that are diffused in a great extent; whereby, one that shall put his eare to that place, where all the severall motions doe meet, shall heare what is spoken so low, as no body between him, and the speaker, can discern any sound at all: Of which kind, there are very fine curiosities in some Churches of England: and my selfe have seen, in an upper room of a capacious round Tower vaulted overhead, the walls so contrived (by chance I beleave) that two men standing at the utmost opposite points of the Diameter of it; could talke very currently and cleerely with one and other; and yet none that stood in the middle could heare a syllable. And if he turned his face to the wall and spoke against that (though never so softly) the others eare, at the opposite point, would discern every word. Which putteth me in mind of a note made by one that was no friend to auricular confession; upon his occasion of his being with me in a Church that had been of a Monastery; where, in one corner of it, one might sit and heare almost all that was whispered through the whole extent of the Church: who would not be perswaded but that it was on purpose contrived so by the subtilty of the Friars; to the end that the Prior or some one of them, might sit there and heare whatsoever the severall Penitents accused themselves of to their ghostly fathers; so to make advantage by this artifice; of what the confessors durst not of themselves immediately reveale.

He allowed better of the use in Rome of making voyces rebound:

bound from the top of the cupula of St. Peters in the Vatican, down to the floore of the Church; when on great daies they make a Quire of Musike goe up to the very highest part of the arch, which is, into the Lanthorne: from whence while they sing, the people below just under it are surpris'd with the smart sound of their voices, as though they stood close by them, and yet can see no body from whom those notes should proceed. And in the same cupula, if two men stand upon the large cornish or bord, which circleth the bottom of it, they may observe the like effect, as that which I spoke of above in the round Tower.

In the like manner, they that are called ventriloqui, do persuade ignorant people, that the diuel speaketh from within them (deep in their belly) by their sucking their breath inwards in a certaine manner whiles they speake: whence it followeth that their voice seemeth to come, not from them, but from somewhat else hidden within them; if (at the least) you perceive it cometh out of them: but if you do not, then it seemeth to come from a good way off.

To this art belongeth the making of Sarabatanes, or Trunks, to helpe the hearing; and of Echo glasses, that multiply sounds, as burning-glasses do light. All which arts, and the rules of them, do follow the laws of motion; and every effect of them is to be demonstrated by the principles and proportions of motion: and therefore, we cannot with reason imagine them to be any thing else.

We see likewise, that great noises, not only offend the hearing, but even shake houses and Towers. I have been told by inhabitants of Dover, that when the Arch-Duke Albertus made his great battery against Calais (which for the time was a very furious one; for he endeavored all he could to take the Town before it could be relieved) the very houses were shaken, and the glasse-windows were shivered, with the report of his Artillery: And I have been told by one that was in Sevill, when the gunpowder-house of that towne (which was some two miles distant from that place where he lived) was blown up, that it made the wooden shutters of the windows in his house, beat and clap against the walls with great violence, and did split the very walls of a faire Church, that standing next it (though at a good distance) had no other building betweene to shelter it from the

³
The same is confirmed by the effects caused by great noises.

impetuosity of the ayres sudden violent motion.

And after a fight I once had with some Galleasses and Gallions in the roade of Scanderone (which was a very hot one for the time; and a scarce credible number of pieces of Ordnance were shot from my fleete) the English Consull of that place comming afterwards aboard my ship, told me that the report of our guns had during all the time of the fight shaken the drinking-glasses that stood upon shelves in his house; and had split the paper-windows all about; and had spoiled and cracked all the egges that his Pigeons were then sitting upon: which losse, he lamented exceedingly; for they were of that kind, which commonly is called *Carriers*, and serve them daily in their commerce between that place and Aleppo.

And I have often observed at sea, in smooth water; that the ordnance shot of in a ship some miles distant, would violently shake the glasse windows in another. And I have perceived this effect in my owne, more then once, at the report of a single gun from a ship so far off, that we could not descry her. I remember how one time upon such an occasion, we altered our course and steared with the sound, or rather with the motion at the first, observing upon which point of the Compasse the shaking appeared (for as we heard nothing; though soon after with much attention and silence we could discern a dull clumisie noise: and such a motion groweth at the end of it so faint, that if any strong resisting body checke it in its course, it is presently deaded, and will afterwards shake nothing beyond that body: and therefore it is perceptible onely at the outside of the ship, if some light and very moveable body do hang loosely on that side it cometh, to receive the impressiion of it; as this did at the gallery windows of my cabin upon the poepe, which were of light Moscovia glasse or talk:) and by then we had run somewhat more then a watch, with all the sails abroad we could make, & in a fair loom gale, we found our salves neere enough to part the fray of two ships, that in a little while longer fighting would have sunk one another.

But besides the motions in the ayre (which received them easily by reason of the fluidity of it) we see that even solide bodies do participate of it. As if you knock never so lightly at one end of the longest beam you can find, it will be distinctly hard at the other end: the trampling of men and horses in a quiet night will

4.
That solid bodies may convey the motion of the ayre to the organe of hearing.

be heard some miles off, if one lay their eare to the ground; and more sensibly if one make a little hole in the earth, and put ones eare into the mouth of it; but most of all if one set a Drum smooth upon the ground, and lay ones eare to the upper edge of it; for the lower membrane of the Drum is shaken by the motion of the earth, and them multiplyeth that sound by the hollow figure of the Drum in the conveying it to the upper membrane, upon which your eare leaneth. Not much unlike the tympane or drum of the eare; which being shaken by outward motion, causeth a second motion on the inside of it correspondent to this first; and this having a free passage to the braine, striketh it immediately and so informeth it how things move without; which is all the mystery of hearing.

If any thing doe breake or stop this motion, before it shake our eare, it is not heard. And accordingly we see that the sound of bells or artillery is heard much further if it have the conduct of waters, then through the pure ayre: because in such bodies the great continuity of them maketh that one part cannot shake alone, and upon their superficies, there is no notable unevenesse, nor no dense thing in the way to checke the motion (as in the ayre, hills, buildings, trees, and such like:) so that the same shaking goeth a great way. And to confirme that this is the true reason, I have severall times observed, that standing by a river side, I have heard the sound of a ring of bells, much more distinctly and lowd, then if I went some distance from the water, though neerer to the steeple from whence the sound came.

And it is not only the motion of the ayre, that maketh sound in our eares: but any motion that hath access to them in such a manner as to shake the quivering membranous tympane within them, will represent unto us those motions which are without, and so make such a sound there as if it were conveyed onely by the ayre. Which is plainly seen, when a man lying a good way under water, shall there heare the same sounds, as are made above in the ayre; but in a more clumisie manner; according as the water, by being thicker, and more corpulent is more unwieldy in its motions. And this I have tried often; staying under water as long as the necessity of breathing would permit me. Which sheweth that the ayre being smartly moved, moveth the water also, by meanes of its continuity with it, and that li-

5.
Where the motion is interrupted there is no sound.

6.
That not onely the motion of the ayre, but all other motions comming to our eares make sounds.

quid element, being fluide and getting into the eare, maketh vibrations upon the drum of it like unto those of ayre.

7.
How one sense
may supply the
want of an
other,

But all this is nothing in respect of what I might in some sort say, and yet speake truth. Which is, that I have seene one, who could discern sounds with his eyes. It is admirable, how one sense will oftentimes supply the want of an other: whereof I have seene an other strange example in a different straine from this; of a man that by his grosser senses had his want of sight wonderfully made up. He was so thoroughly blind, that his eyes could not informe him when the Sunne shined; for all the crytalline humour was out in both his eyes: yet his other senses instructed him so efficaciously in what was their office to have done; as what he wanted in them, seemed to be overpayed in other abilities. To say that he would play at cards and tables as well as most men; is rather a commendation of his memory and fanisie, then of any of his outward senses. But that he should play well at boules and shovelbord, and other games of ayme, which in other men doe require cleare sight, and an exact levell of the hand according to the qualities of the earth or table, and to the situation and distance of the place he was to throw at, seemeth to exceed possibility: and yet he did all this.

He would walke in a chamber or long alley in a garden (after he had been a while used to them) as straight, and turne as just at the ends, as any seeing man could doe. He would goe up and downe everywhere so confidently, and demeane himselfe at table so regularly, as strangers have sitten by him severall meales and have seen him walke about the house, without ever observing any want of seeing in him: which he endeavoured what he could to hide, by wearing his hat low upon his browes. He would, at the first abord of a stranger, as soone as he spoke to him, frame a right apprehension of his stature bulke and manner of making. And which is more, when he taught his schollers to declame (for he was schoolmaster to my sonnes, and lived in my house) or to represent some of Seneca's Tragedies, or the like, he would by their voyce know their gesture, and the situation they put their bodies in: so that he would be able, as soon as they spoke, to judge whether they stood or sate, or in what posture they were; which made them demeane themselves as decently before him whiles they spoke, as if he had seen them perfectly.

Though

Though all this be very strange, yet me thinks his discerning of light is beyond it all. He would feele in his body, and chiefly in his braine (as he hath often told me) a certain effect by which he did know when the Sunne was up; and would discern exactly a cleare from a cloudy day. This I have known him frequently doe without missing; when for triall sake he hath been lodged in a close chamber, whereunto the cleare light or Sunne could not arrive to give him any notice by its actuall warmth; nor any body could come to him; to give him private warnings of the changes of the weather.

But this is not the relation I intended; when I mentioned one that could heare by his eyes; (if that expression may be permitted me) I then reflected upon a Noble man of great quality that I knew in Spaine, the younger brother of the Constable of Castile. But the reflection of his seeing of words, called into my remembrance the other that felt light: in whom I have often remarked so many strange passages, with amazement and delight; that I have adventured upon the Readers patience to record some of them, conceiving they may be of some use in our course of doctrine. But the Spanish Lord was born deafe; so deafe, that if a Gun were shot off close by his eare, he could not heare it: and consequently, he was dumbe, for not being able to heare the sound of words, he could never imitate nor understand them. The lovelinesse of his face, and especially the exceeding life and spiritulnesse of his eyes, and the comelinesse of his person and whole composure of his body throughout, were pregnant signes of a well tempered mind within. And therefore all that knew him, lamented much the want of meanes to cultivate it, and to imbrue it with the notions which it seemed to be capable of in regard of its selfe; had it not been so crossed by this unhappy accident. Which to remedy Physitians and Chirurgicalians had long imployed their skill; but all in vaine. At the last, there was a Priest who undertooke the teaching him to understand others when they spoke, and to speake himselfe that others might understand him. What at the first he was laught at for, made him after some yeeres be looked upon as if he had wrought a miracle. In a word; after strange patience, constancy and paines, he brought the young Lord to speake as distinctly as any man whosoever; and to understand so perfectly what

8.
Of one who
could discern
found of
words with
his eyes.

others said that he would not lose a word in a whole daies conversation.

They who have a curiosity to see by what steps the master proceeded in teaching him, may satisfie it by a booke which he himself hath writ in Spanish upon that subject, to instruct others how to teach deafe and dumbe persons to speake. Which when he shall have looked heedfully over; and shall have considered what a great distance there is betweene the simplicity and nakednesse of his first principles; and the strange readinesse and vast extent of speech resulting in proesse of time out of them; he will forbear pronouncing an impossibility in their pedegree, whiles he wondreth at the numerous effects resulting in bodies out of rarity and density, ingeniously mingled together by an all knowing Architect, for the production of various qualities among mixts, of strange motions in particular bodies; and of admirable operations of life and sense among vegetables and animals. All which are so many severall words of the mysticall language, which the great master hath taught his otherwise dumbe schollers (the creatures) to proclaime his infinite art, wisdome, perfections, and excellency in.

The Priest who by his booke and art occasioned this discourse, I am told is still alive, and in the service of the Prince of Carignan, where he continueth (with some that have need of his paines) the same employment as he did with the Constables brother: with whom I have often discoursed; whiles I waited upon the Prince of Wales (now our gracious Sovereigne) in Spaine. And I doubt not but His Majesty remembreth all I have said of him and much more: for His Majesty was very curious to observe and enquire into the utmost of it. It is true, one great misbecomingnesse he was apt to fall into, whiles he spoke: which was an uncertainty in the tone of his voyce; for not hearing the sound he made when he spoke, he could not steddily governe the pitch of his voyce; but it would be sometimes higher, sometimes lower; though for the most part, what he delivered together, he ended in the same key as he begun it. But when he had once suffered the passage of his voice to close, at the opening them againe, chance, or the measure of his earnestnesse to speake or to reply, gave him his tone: which he was not capable of moderating by such an artifice, as is recorded **Caius Gracchus** used,

when

when passion, in his orations to the people, drove out his voyce with too great a vehemence or shrillnesse.

He could discern in another, whether he spoke shrill or low: and he would repeate after any body, any hard word whatsoever. Which the Prince tryed often; not onely in English, but by making some Welchmen that served his Highnesse, speake words of their language. Which he so perfectly ecchoed, that I confesse I wondered more at that, then at all the rest. And his Master himselfe would acknowledge, that the rules of his art reached not to produce that effect with any certainty. And therefore concluded, this in him must spring from other rules he had framed unto himselfe, out of his own attentive observation: which, the advantage that nature had justly given him in the sharpenesse of his other senses, to supply the want of this; endowed him with an ability and sagacity to do, beyond any other man that had his hearing. He expressed it (surely) in a high measure, by his so exact imitation of the Welch pronunciation: for that tongue (like the Hebrew) employeth much the gutturall Letters: and the motions of that part which frameth them, cannot be seene nor judged by the eye, otherwise then by the effect they may happily make by consent in the other parts of the mouth, exposed to view: for the knowledge hee had of what they said, sprung from his observing the motions they made; so that hee could converse currently in the light, though they he talked with, whispered never so softly. And I have seene him at the distance of a large chambers breadth, say words after one, that I standing close by the speaker could not heare a syllable of. But if he were in the darke, or if one turned his face out of his sight, he was capable of nothing one said.

But it is time that we returne to our theame, from whence my blind Schoolemaster, and this deafe Prince (whose defects were overpayed an other way) have carried us with so long a digression. Which yet will not be altogether uselesse (no more then the former, of the wild man of Liege) if wee make due reflections upon them: for when we shall consider, that odors may be tasted; that the relish of meates may be smelled; that magnitude and figure may be heard; that light may be felt, and that sounds may be seen; (all which is true in some sense) we may by this changing the offices of the senses; and by looking

9.
Divers reasons
to prove sound
to be nothing
else but a mc-
tion of some
reall body.

into

into the causes thereof; come to discern that these effects are not wrought by the intervention of any qualities; but by real and material applications of bodies to bodies; which in different manners do make the same results within us.

But when I suffered my pen to be steered by my fantasie; that pleased it selfe, and rioted in the remembrance of these two notable persons: I was speaking, how the strong continuity of the parts of a thing that is moved, draweth on the motion, and consequently the sound, much further then where that which is moved suffereth breaches, or the rarity of it occasioneth that one part may be moved without an other; for to the proportion of the shaking, the noise continueth. As we see in trembling bells, that hum a great while longer then others, after the Clapper hath stricken them: and the very sound seemeth to quiver and shake in our eares, proportionable to the shaking of the bell. And in a Lute as long as a string that hath been stricken, shaketh sensibly to our eye; so long, and to the same measure, the sound shaketh in our eare. Which is nothing else but an undulation of the Ayre, caused by the smart and thick vibrations of the corde, and multiplied in the belly of the instrument (which is the reason that the concave figure is affected in most) and so when it breaketh out of the instrument in greater quantity, then the string immediately did shake; it causeth the same undulations in the whole body of Ayre round about. And that striking the Drum of the eare, giveth notice therein what tenour the string moveth: whose vibrations if one stop by laying his finger upon it, the sound is instantly at an end; for then there is no cause on foot, that continueth the motion of the Ayre: which, without a continuation of the impulse, returneth speedily to quiet; through the resistance made unto it, by other parts of it that are further off.

Out of all which it is plaine, that motion alone is able to effect and to give account of all things whatsoever that are attributed to sound; and that sound and motion, do goe hand in hand together; and that whatsoever is said of the one, is likewise true of the other. Wherefore it cannot be denied but that *hearing* is nothing else but the due perception of *motion*: and that *motion* and *sound* are in themselves one and the same thing, though expressed by different names, and comprised in our understanding

derstanding under different notions. Which proposition seemeth to be yet further convinced, by the ordinary experience of perceiving musike by mediation of a stick; for how should a deafe man be capable of musick by holding a stick in his teeth, whose other end lyeth upon the Viall or Virginalls, were it not that the proportionall shaking of the stick (working a like dauncing in the mans head) did make a like motion in his braine, without passing through his eare? and consequently, without being otherwise *found*, then as bare motion is *found*.

Or if any man will still persist in having sound be some other thing then as wee say; and that it affecteth the sense otherwise then purely by motion: hee must nevertheless acknowledge, that whatsoever it be, it hath neither cause nor effect, nor breeding, nor dying, that we either know or can imagine: and then; if he will let reason sway, hee will conclude it unreasonable to say or suspect so ill grounded a surmise, against so cleare and solid proofes: which our eares themselves do not a little confirm; their whole figure and nature tending to the perfect receiving, conserving, and multiplying the motions of ayre which happen without a man: as who is curious, may plainly see in the Anatomists books and discourses.

THE NINE AND TWENTIETH CHAP.

Of Sight, and Colours.

THere is yet left, the object of our sight, *which we call colours*, to take a survey of; for as for *light*, wee have at large displayed the nature and properties of it: from which whether colour be different or no, will be the question we shall next discusse: for those who are cunning in Optikes, will by refractions and by reflexions make all sorts of colours out of pure light: as we see in Rainebowes, in those triangular glasses, or prisms which some do call *fooles Paradises*, and in other inventions for this purpose. Wherefore, in brieft, to shew what colour is, let us lay for a ground, that light is of all other things in the world, the greatest and the most powerfull agent upon our eye; either by it selfe, or by what commeth in with it: and that,

I.
That colours are nothing but light mingled with darknesse; or the disposition of a bodies superficies apt to reflect light so mingled.

that, where light is not, darkeneffe is ; then consider, that light being diversly to bee cast, but especially, through or from a transparent body, into which it sinketh in part, and in part it doth not : and you will conclude, that it cannot choose but come out from such a body, in divers sorts mingled with darkeneffe : which if it bee in a sensible quantity, doth accordingly make divers appearances : and those appearances must of necessity have divers hues, representing the colours which are middle colours betweene white and black ; since white is the colour of light, and darkeneffe seemeth black. Thus, those colours are ingendred, which are called apparent ones. And they appeare sometimes but in some one position ; as in the rainebow ; which changeth place as the looker on doth : but at other times, they may bee seen from any part ; as those which light maketh by a double refraction through a triangular glasse

And that this is rightly delivered, may be gathered out of the conditions requisite to their production : for that crystall, or water, or any refracting body, doth not admit light in all its parts, is evident, by reason of the reflection that it maketh, which is exceeding great : and not onely from the superficies, but even from the middle of the body within : as you may see plainly, if you put it in a darke place, and enlighten but one part of it : for then, you may perceive, as it were, a current of light passe quite through the body, although your eye be not opposite to the passage : so that manifestly it reflecteth to your eye, from all the inward parts which it lighteth upon.

Now a more oblique reflection or refraction doth more disperse the light, and admitteth more privations of light in its parts, then a lesse oblique one : as Galileo hath demonstrated in the first Dialogue of his systeme. Wherefore, a lesse oblique reflection or refraction, may receive that in quality of light, which a more oblique one maketh appeare mingled with darkeneffe ; and consequently, the same thing will appeare colour in one, which sheweth it selfe plaine light in the other ; for the greater the inclination of an angle is, the greater also is the dispersion of the light.

And as colours are made in this sort, by the medium through which light passeth, so if we conceive the superficies from which the light reflecteth, to be diversly ordered in respect of reflexi-

on; it must of necessity follow that it will have a divers lustre and sight: as we see by experience in the necks of Pigeons, and in certaine positions of our eye, in which the light passing through our eye browes, maketh an appearance as though we saw divers colours streaming from a candle we looke upon. And accordingly we may observe how some things, or rather most, do appeare of a colour more inclining to white, when they are irradiated with a great light, then when they stand in a lesser. And we see painters heighten their colours, and make them appeare lighter by placing deepe shadowes by them: even so much, that they will make objects appeare neerer and further off, meerly by their mixtion of their colours. Because, objects, the neerer they are, the more strongly and lively they reflect light, and therefore, appeare the clearer, as the others do more dusky.

Therefore, if wee put the superficies of one body to have a better disposition for the reflection of light, then an other hath; wee cannot but conceive, that such difference in the superficies, must needs beget variety of permanent colours in the bodies. And according as the superficies of the same body, is better, or worse disposed to reflection of light, by polishing, or by compressure together, or the like: so, the same body, remaining the same in substance, will shew it selfe of a different colour. And it being evident that white (which is the chiefeest colour) doth reflect most light: and as evident, that blacke reflecteth least light, so that it reflecteth shadowes in lieu of colours. (as the Obsidian stone among the Romans doth witnesse.) And it being likewise evident, that to be dense and hard, and of small parts, is the disposition of the object which is most apt to reflect light: wee cannot doubt, but that *white* is that disposition of the superficies. That is to say, it is the superficies of a body consisting of dense, of hard, and of small parts; and on the contrary side, that black is the disposition of the superficies, which is most soft and full of greatest pores; for when light meeteth with such a superficies, it getteth easily into it; and is there, as it were absorpt and hidden in caves, and commeth not out againe to reflect towards our eye.

This doctrine of ours of the generation of colours, agreeth exactly

2.
Concerning
the disposition
of those bodies
which produce
white or black
colours.

3.
The former doctrine confirmed by Aristotles authority, reason, and experience.

exactly with *Aristotles* principles, and followeth evidently out of his definitions of *light*, and of colours. And for summing up the generall sentiments of mankind in making his Logicall definitions, I thinke no body will deny his being the greatest Master that ever was. Hee defineth light to be *actus Diaphani*: which we may thus explicate. It is that thing, which maketh a body that hath an aptitude or capacity of being seene quite through it in every interior part of it, to be actually seene quite through, according to that capacity of it. And hee defineth colour to be, *The terme or ending of a diaphanous body*: the meaning whereof is: that colour is a thing which maketh a diaphanous body to reach no further; or that colour is the cause why a body is no further diaphanous, then untill where it beginneth; or that colour is the reason, why we can see no further then to such a degree, through or into such a body.

Which definition fitteth most exactly with the thing it giveth us the nature of. For it is evident, that when we see a body, the body we see, hindereth us from seeing any other, that is in a straight line beyond it. And therefore it cannot be denied, but that colour terminateth, and endeth the diaphaneity of a body, by making it selfe be seene. And all men do agree in conceiving this, to be the nature of colour; and that it is a certaine disposition of a body, whereby that body commeth to be seene. On the other side, nothing is more evident, then that to have us see a body, light must reach from that body to our eye. Then adding unto this what Aristotle teacheth concerning the production of seeing: which he sayth is made by the action of the seene body upon our sense: it followeth that the object must worke upon our sense, either by light, or at the least with light; for light rebounding from the object round about by straight lines, some part of it must needs come from the object to our eye. Therefore, by how much an object sendeth more light unto our eye, by so much, that object worketh more upon it.

Now seeing that divers objects do send light in divers manners to our eye, according to the divers natures of those objects in regard of hardnesse, density, and littleness of parts: we must agree that such bodies do worke diversly, and do make different motions or impressions upon our eye: and consequent-

ly,

ly, the passion of our eye from such objects must be divers. But there is no other diversity of passion in the eye from the object in regard of seeing, but that the object appeare divers to us in point of colour. Therefore we must conclude, that divers bodies (I meane divers or different, in that kind wee here talke of) must necessarily seeme to be of divers colours, meerly by the sending of light unto our eye in divers fashions. Nay, the very same object must appeare of different colours, whensoever it happeneth that it reflecteth light differently to us. As we see in cloth, if it be gathered together in fouldes, the bottomes of those fouldes shew to be of one kind of colour, and the tops of them; or where the cloth is stretched out to the full percussion of light, it appeareth to be of an other much brighter colour. And accordingly painters are faine to use almost opposite colours to expresse them. In like manner if you looke upon two pieces of the same cloth, or pluh, whose graines lye contrawise to one an other, they will likewise appeare to be of different colours. Both which accidents, and many others like unto them in begetting various representations of colours; do all of them arise out of lights being more or lesse reflected from one part then from an other.

Thus then you see, how colour is nothing else, but the disposition of a bodies superficies, as it is more or lesse apt to reflect light; sithence the reflection of light is made from the superficies of the seen body, and the variety of its reflexion begetteth variety of colours. But a superficies is more or lesse apt to reflect light, according to the degrees of its being more or lesse penetrable by the force of light striking upon it; for those rayes of light that gaine no entrance into a body they are darted upon, must of necessity fly back againe from it. But if light doth get entrance and penetrate into the body, it either passeth quite through it; or else it is swallowed up and lost in that body. The former, constituteth a diaphanous body; as we have already determined. And the semblance which the latter will have in regard of colour, we have also shewed must be black.

But let us proceede a little further. Wee know that two things render a body penetrable, or easie to admit an other body into it. Holes, (such as we call pores) and softnesse or humidity; so that drynesse, hardnesse, and compactednesse, must be the properties

4.
How the diversity of colours do follow out of various degrees of rarity and density.

properties which render a body impenetrable. And accordingly we see, that if a diaphanous body (which suffereth light to run through it) be much compressed beyond what it was; as when water is compressed into yce; it becometh more visible, that is, reflecteth more light: and consequently; it becometh more white; for white is that, which reflecteth most light.

On the contrary side, softnesse, unctuousnesse, and viscosnesse, encreaseth blacknesse: as you may experience in oyling or in greasing of wood; which before was but brown, for thereby it commeth more black; by reason that the unctuous parts added unto the other, do more easily then they single, admit into them the light that striketh upon them; and when it is gotten in, it is so entangled there (as though the wings of it were birdlimed over) that it cannot fly out againe. And thus it is evident, how the origine of all colours in bodies, is plainly deduced out of the various degrees of rarity and density; variously mixed and compounded.

5.
Why some bodies are Diaphanous, others opacous.

Likewise, out of this discourse, the reason is obvious why some bodies are diaphanous and others are opacous: for sithence it falleth out in the constitution of bodies, that one is composed of greater parts then an other: it must needs happen that light be more hindered in passing through a body composed of bigger parts, then an other whose parts are lesse. Neither doth it import that the pores be supposed as great as the parts, for be they never so large, the corners of the thicke parts they belong unto, must needs break the course of what will not bow, but goeth all in straight lines; more then if the parts and pores were both lesse; since, for so subtile a piercer as light, no pores can be too little to give it entrance. It is true such great ones would better admit a liquid body into them, such a one as water or ayre; but the reason of that is, because they will bow and take any ply, to creep into those cavities, if they be large enough, which light will not do.

Therefore it is cleare, that freedome of passage can happen unto light, only there, where there is an extreme great multitude of pores and parties in a very little quantity or bulke of body (which pores and parts must consequently be extreme little ones) for, by reason of their multitude, there must be great variety in their situation: from whence it will happen that many

many lines must be all of pores quite through; and many others all of parts; although the most, will be mixed of both pores and parts. And so we see that although the light do passe quite through in many places, yet it reflecteth from more, not onely in the superficies, but in the very body it selfe of the Diaphanous substance. But in an other substance of great parts, and pores there can be but few whole lines of pores, by which the light may passe from the object to make it be seene; and consequently it must be opacous; which is the contrary of Diaphanous that admitteth many rayes of light, to passe through it from the object to the eye, whereby it is seene, though the Diaphanous hard body, do intervene betweene them.

Now if wee consider the generation of these two colours (white and black) in bodies; we shall find that likewise to justify and second our doctrine: for white things are generally cold and dry; and therefore, are by nature ordained to be receptacles, and conservers of heat, and of moysture; as Physicians do note. Contrariwise, black, as also greene, (which is neere of kinne to black) are growing colours, and are the die of heate incorporated in abundance of wet: as we see in smoake, in pitcoale, in garden ground; and in chymicall putrefactions: all which are black; as also in yong herbes; which are generally greene as long as they are yong and growing. The other colours, keeping their standing betwixt these, are generated by the mixture of them; and according as they partake more or lesse of either of them, are neerer or further off from it.

So that after all this discourse, we may conclude in short, that the colour of a body, is nothing else, but the power which that body hath of reflecting light unto the eye, in a certaine order and position: and consequently, is nothing else but the very superficies of it, with its asperity, or smoothnesse; with its pores, or inequalities; with its hardnesse, or softnesse; and such like. The rules and limits whereof, if they were duly observed and ordered, the whole nature and science of colours, would easily be knowne and be described. But out of this little which we have delivered of this subject, it may be rightly inferred that reall colours do proceed from rarity and density, (as even now we touched) and have their head & spring there: and are not strange

6.

The former doctrine of colours confirmed by the generation of white and black in bodies.

qualities in the Ayre: but are tractable bodies on the earth, as all others are, which, as yet wee have found and have meddied withall: and are indeed, the very bodies themselves, causing such effects upon our eye by reflecting of light, which wee expresse by the names of colours.

THE THIRTIETH CHAP.

Of luminous or apparent Colours.

1.
Apparitions
of colours
through a pris-
me or triangu-
lar glasse are of
two sorts,

AS for the luminous colours, whose natures art hath made more maniable by us, then those which are called reall colours, and are permanent in bodies: their generation is cleerely to bee seene in the prisme or triangular glasse wee formerly mentioned. The considering of which, will confirme our doctrine, that even the colours of bodies, are but various mixtures of light and shadowes, diversly reflected to our eyes. For the right understanding of them, wee are to note, that this glasse maketh apparitions of colours in two sorts: the one, when looking through it there appeare various colours in the objects you looke upon (different from their reall ones) according to the position you hold the glasse in when you looke upon them. The other sort is, when the beames of light that passe through the glasse, are as it were tinted in their passage, and are cast by the glasse upon some solid object, and doe appeare there in such and such colours, which doe continue still the same, in what position soever you stand to look upon them; either before, or behind, or on any side of the glasse.

2.
The severall
parts of the ob-
ject make sever-
all angles at
their entrance
into the prisme

Secondly, we are to note that these colours are generally made by refraction (though sometimes it may happen otherwise, as above we have mentioned.) To discover the reason of the first sort of colours, that appeare by refraction when one looketh through the glasse: let us suppose two severall bodies, the one black, the other white, lying close by one another, and in the same horizontall parallele: but so, that the black be further from us then the white; then, if we hold the prisme through which we are to see these two oppositely coloured bodies some-
what

what above them ; and that side of it at which the coloured bodies must enter into the glasse to come to our eye, parallel unto those bodies ; it is evident, that the black will come into the prisme by lesser angles, then the white : I meane that in the line of distance from that face of the glasse at which the colours do come in, a longer line or part of black will subtend an angle, no bigger, then a lesser line or part of white doth subtend.

Thirdly, we are to note, that from the same point of the object ; there come various beames of light to that whole superficies of the glasse ; so that it may, and sometimes doth happen, that from the same part of the object, beames may be reflected to the eye, from severall parts of that superficies of the glasse at which they enter. And whensoever this happeneth, the object must necessarily be seene in divers parts : that is, the picture of it will at the same time appeare to the eye in divers places. And particularly, we may plainly observe two pictures, one a lively and strong one ; the other a faint and dim one. Of which the dim one will appeare neerer us, then the lively one : and is caused by a secondary ray : or rather I should say, by a longer ray, that striking neerer to the hither edge of the glasses superficies (which is the furthest from the object) maketh a more acute angle then a shorter ray doth ; that striketh upon a part of the glasse further from our eye, but neerer the object. And therefore the image which is made by this secondary or longer ray, must appeare both neerer and more dusky ; then the image made by the primary and shorter ray. And the further from the object that the glasse through which it reflecteth is situated (keeping still in the same parallel to the horizon) the further the place, where the second dusky picture appeareth, is from the place where the primary strong picture appeareth.

If any man have a mind to satisfy himselfe by experience, of the truth of this note, let him place a sheet of white paper upon a black carpet covering a table, so as the paper may reach within two or three fingers of the edge of the carpet ; (under which, let there be nothing to succeed the black of the carpet, but the empty dusky Ayre) and then let him set himselfe at a convenient distance, (the measure of which is, that the paper appeare at his feet, when hee looketh through the glasse) and

3.
The reason why sometimes the same object appeareth through the prisme in two places ; and in one place more lively, in the other place more dim.

looke at the paper through his prisme situated in such sort as we have above determined, and he will perceive a whitish or light-some shadow proceed from the lively picture that he seeth of white, and shoote out neerer towards him then that lively picture is, and he will discern that it commeth into the glasse through a part of it neerer to his eye or face, and further from the object then the strong image of the white doth. And further, if he causeth the neerer part of the paper to be covered with some thin body of a sadder colour, this dim white vanisheth: which it doth not if the further part of the paper be covered. Whereby it is evident, that it is a secondary image, proceeding from the hither part of the paper.

4.
The reason
of the various
colours that
appear in
looking
through a
prisme.

Now then to make use of what we have said to the finding out of the reason why the red and blew and other colours appear when one looketh through a prisme: let us proceed upon our former example, in which a white paper lyeth upon a black carpet (for, the diametrall opposition of those colours maketh them most remarkable) in such sort that there be a parcell of black on the hither side of the paper: and therein, let us examine according to our grounds, what colours must appear at both ends of the paper, looking upon them through the triangular glasse.

To begin with the furthest end, where the black lyeth beyond the white: we may consider, how there must come from the black, a secondary darke misty shadow (besides the strong black that appeareth beyond the paper) which must shoote towards you (in such sort as we said of the whitish light-some shadow) and consequently, must ly over the strong picture of the white paper: now in this case, a third middling colour must result out of the mixture of these two extremes of black and white; since they come to the eye, almost in the same line, at the least in lines that make so little a difference in their angles as it is not discernable.

The like whereof happeneth in Clothes, or Stuffs, or Stockings, that are woven of divers coloured but very small threds: for you stand so far off from such a piece of Stuffs, that the little threds of different colours which lye immediate to one another may come together as in one line to your eye; it will appear of a middling colour, different from both those that it

releth

resulteth from : but if you stand so neere that each thred sendeth rayes enough to your eye, and that the basis of the triangle which commeth from each thred to your eye, be long enough to make at the vertex of it (which is in your eye) an angle big enough to be seene singly by it selfe ; then each colour will appeare a part as it truly is.

Now the various natures of middling colours we may learne of painters ; who compose them upon their palettes by a like mixture of the extremes. And they tell us, that if a white colour prevaile strongly over a darke colour, reds and yellowes result out of that mixture : but if black prevaile strongly over white, then blewes, violets, and seagreenes are made. And accordingly, in our case, we cannot doubt but that the primary lively picture of the white, must prevaile over the faint dusky sable mantle with which it commeth mingled to the eye : and doing so, it must needs make a like appearance as the Sunnes beames do, when reflecting from a black cloud, they fringe the edges of it with red and with yellow ; and the like he doth, when he looketh through a rainy or a windy cloude : and much like hereunto, we shall see this mixture of strong white with a faint shadow of black, make at this brim of the paper, a faire ledge of red ; which will end and vanish, in a more lightsome one of yellow.

But at the hither edge of the paper, where the secondary weake picture of white is mingled with the strong black picture, in this mixture, the blacke is prevalent, and accordingly (as we said of the mixture of the painters colours) there must appeare at the bottome of the paper, a Lembe of deepe blew : which will grow more and more lightsome, the higher it goeth : and so, passing through violet and seagreene it will vanish in light, when it reacheth to the mastering field of primary whitenesse, that sendeth his stronger rayes by direct lines : and this transposition of the colours at the severall ends of the paper sheweth the reason why they appeare quite contrary, if you put a black paper upon a white carpet. And therefore, we need not add any thing particularly concerning that.

And likewise, out of this we may understand, why the colours appeare quite contrary (that is, red where before blew appeared ; and blew, where red) if wee looke upon the same

5. The reason why the prisme in one position, may make the colours appeare quite contrary to what they did, when it was in an other position.

object through the glasse in an other position or situation of it : namely, if we rayse it so high, that we must looke upwards to see the object ; which thereby appeareth above us : whereas in the former situation, it came in through the lower superficies, and we looked downe to it, and it appeared under us: for in this second case, the objects comming into the glasse by a superficies not parallel as before, but sloaping, from the objectwards : it followeth, that the neerer the object is, the lesser must the angle be, which it maketh with the superficies ; contrary to what happened in the former case : and likewise, that if from one point of the neerer object, there fall two rayes upon the glasse, the ray that falleth uppermost, will make a lesser angle, then the other that falleth lower : and so, by our former discourse, that point may come to appeare in the same place with a point of the further object; and thereby make a middling colour.

So that in this case, the white which is neerer, will mingle his feeble picture with the black that is further off : whereas before the black that was further off, mingled his feeble shadow with the strong picture of the neerer white. Wherefore by our rule we borrowed of the painters, there will now appeare a blew on the further end of the paper, where before appeared a red ; and by consequence on the neerer end a red will now appeare, where in the former case a blew appeared. This case we have chosen, as the plainest to shew the nature of such colours : out of which he that is curious, may derive his knowledge to other cases, which wee omit ; because our intent is onely to give a generall doctrine, and not the particulars of the Science : and rather to take away admiration, then to instruct the Reader in this matter.

6. The reason of the various colours in generall by pure light passing through a prisme.

As for the various colours, which are made by straying light through a glasse, or through some other Diaphanous body ; to discover the causes and variety of them, we must examine what things they are that do concurre to the making of them : and what accidents may arrive unto those things, to vary their product. It is cleare, that nothing interveneth or concurreth to the producing of any of these colours, besides the light it selfe which is dyed into colour, and the glasse or Diaphanous body through which it passeth. In them therefore, and in nothing else, we are to make our enquiry.

To begin then, wee may observe, that light passing through a prisme, and being cast upon a reflecting object, is not alwayes colour; but in some circumstances it still continueth light, and in others it becommeth colour. Withall wee may observe that those beames which continue light, and endure very little mutation by their passage, making as many refractions, do make much greater deflexions from the straight lines by which they came into the glasse, then those rayes doe which turne to colour; as you may experience, if you oppose one surface of the glasse perpendicularly to a Candle, and set a paper (not irradiated by the candle) opposite to one of the other sides of the glasse: for upon the paper, you shall see faire light shine without any colour: and you may perceive, that the line by which the light commeth to the paper, is almost perpendicular to that line by which the light commeth to the Prisme. But when light becommeth colour, it striketh very obliquely upon one side of the glasse; and commeth likewise, very obliquely out of the other, that sendeth it in colour upon a reflectent body; so that in conclusion, there is nothing left us whereupon to ground the generation of such colours, besides the littlenesse of the angle and the sloapingnesse of the line, by which the illuminant striketh one side of the glasse, and commeth out at the other, when colours proceed from such a percussion.

To this then we must wholly apply our selves: and knowing that generally, when light falleth upon a body with so great a sloaping or inclination, so much of it as getteth through, must needs be weake and much diffused; it followeth that the reason of such colours, must necessarily consist in this diffusion and weakenesse of light; which the more it is diffused, the weaker it groweth; and the more lines of darknesse, are between the lines of light, and do mingle themselves with them.

To confirme this, you may observe, how just at the egressie from the prisme of that light which going on a little further becommeth colours, no colour at all appeareth upon a paper opposed close to the side of the glasse; untill removing it further off, the colours begin to shew themselves upon the edges: thereby convincing manifestly, that it was the excesse of light which hindered them from appearing at the first. And in like manner, if you put a burning glasse betweene the light and the prisme,

so as to multiply the light which goeth through the prisme to the paper, you destroy much of the colour by converting it into light. But on the other side, if you thicken the ayre, and make it dusky with smoake, or with dust; you will plainly see, that where the light commeth through a convexe glasse (perpendicularly opposed to the illuminant) there will appeare colours on the edges of the cones that the light maketh: and peradventure the whole cones would appeare coloured if the darkning were conveniently made: for if an opacous body be set within either of the cones, its sides will appeare coloured, though the ayre be but moderately thickned: which sheweth that the addition of a little darknesse, would make that which otherwise appeareth pure light, be throughly dyed into colours. And thus you have the true and adequate cause of the appearance of such colours.

7.
Upon what
side every co-
lour appeareth
that is made
by pure light
passing through
a prisme.

Now, to understand what colours, and upon which sides, will appeare: we may consider, that when light passeth through a glasse, or other diaphanous body, so much of it as shineth in the ayre, or upon some reflecting body bigger then it selfe, after its passage through the glasse, must of necessity have darknesse on both sides of it; and so be comprised and limited by two darknesse: but if some opacous body, that is lesse then the light, be put in the way of the light, then it may happen contrariwise, that there be darknesse (or the shadow of that opacous body) between two lights.

Againe, we must consider, that when light falleth so upon a prisme as to make colours, the two outward rayes which proceed from the light to the two sides of the superficies at which the light entereth, are so refracted that at their comming out againe through the other superficies, that ray which made the lesse angle with the outward superficies of the glasse, going in, maketh the greater angle with the outside of the other superficies, comming out: and contrariwise, that ray which made the greater angle, going in, maketh the lesser, at its comming out: and the two internall angles, made by those two rayes; and the outside of the superficies they issue at, are greater then two right angles: and so we see that the light dilateth it selfe at its comming out.

Now, because rayes that issue through a superficies, the neerer they

they are to be perpendiculars unto that superficies, so much the thicker they are: it followeth; that this dilatation of light at its coming out of the glasse, must be made and must encrease from that side where the angle was least at the going in, and greatest at the coming out: so that, the neerer to the contrary side you take a part of light, the thinner the light must be there: and contrariwise, the thicker it must be, the neerer it is unto the side where the angle at the rayes coming out is the greater. Wherefore, the strongest light, (that is, the place where the light is least mixed with darknesse) must be neerer that side then the other. Consequently hereunto, if by an opacous body you make a shadow comprehended within this light, that shadow must also have its strongest part, neerer unto one of the lights betwixt which it is comprised, then unto the other: for, shadow being nothing else, but the want of light, hindred by some opacous body, it must of necessity lie aversted from the illuminant, just as the light would have laine if it had not been hindred. Wherefore, seeing that the stronger side of light, doth more impeach the darknesse, then the feebler side doth; the deepest darke must incline to that side, where the light is weakest; that is, towards that side on which the shadow appeareth, in respect of the opacous body or of the illuminant, and so be a cause of deepnesse of colour on that side, if it happen to be fringed with colour.

THE ONE AND THIRTIETH CHAPTER.

The causes of certaine appearances in luminous colours; with a conclusion of the discourse touching the senses and the sensible qualities.

Out of these grounds we are to seeke the resolution of all such symptoms as appear unto us in this kind of colours. First therefore calling to mind, how we have already declared, that the red colour is made by a greater proportion of light mingled with darknesse, and the blew with a lesse proportion: it must follow, that when light passeth through a glasse in such sort as to make colours; the mixture of the light and darknesse on that side where the light is strongest will encline to a red:

The reason of each severall colour in particular caused by light passing through a prisme.

red: and their mixture on the other side, where the light is weakest, will make a violet or blew: and this we see to fall out accordingly, in the light which is rincted by going through a prisme; for a red colour appeareth on that side from which the light doth dilate or encrease, and a blew is on that side towards which it decreaseth.

Now if a darke body be placed within this light, so as to have the light come on both sides of it: we shall see the contrary happen about the borders of the picture or shadow of the darke body: that is to say, the red colour will be on that side of the picture which is towards or over against the blew colour that is made by the glasse: and the blew of the picture will be on that side which is towards the red that is made by the glasse, as you may experience if you place a slender opacous body along the prisme in the way of the light, either before or behind the prisme. The reason whereof is, that the opacous body standing in the middle, environed by light, divideth the light, and maketh two lights of that which was but one; each of which lights, is comprised between two darkneses, to wit, between each border of shadow that joyneth to each extreame of the light that cometh from the glasse, and each side of the opacous bodies shadow. Wherefore, in each of these lights, or rather in each of their commixtions with darknesse, there must be red on the one side, and blew on the other; according to the course of light which we have explicated.

And thus it falleth out, agreeable to the rule we have given, that blew commeth to be on that side of the opacous bodies shadow on which the glasse casteth red, and red on that side of it on which the glasse casteth blew: likewise when light going through a convexe glasse maketh two cones, the edges of the cone betwixt the glasse and the point of concurrence will appeare red, if the roome be darke enough: and the edges of the further cone, will appeare blew, both for the reason given: for in this case the point of concurrence is the strong light betwixt the two cones: of which, that betwixt the glasse and the point, is the stronger, that beyond the point the weaker: and for this very reason, if an opacous body be put in the axis of these two cones, both the sides of its picture will be red, if it be held in the first cone which is next to the glasse; and both will be blew if the body be situated

in the further cone; for both sides being equally situated to the course of the light, within its owne cone, there is nothing to vary the colours, but onely the strength and the weaknesse of the two lights of the cones, on this side, and on that side the point of concurrence: which point, being in this case the strong and cleare light whereof we made generall mention in our precedent note, the cone towards the glasse and the illuminant, is the stronger side, and the cone from the glasse, is the weaker.

In those cases, where this reason is not concerned, we shall see the victory carried in the question of colours, by the shady side of the opacous body: that is, the blew colour will still appeare on that side of the opacous bodies shadow that is furthest from the illuminant. But where both causes doe concur and contrast for precedence, there the course of the light carrieth it: that is to say, the red will be on that side of the opacous bodies shadow where it is thicker and darker, and blew on the other side where the shadow is not so strong; although the shadow be cast that way that the red appeareth: as is to be seen, when a slender body is placed betwixt the prisme and the reflectent body, upon which the light and colours are cast through the prisme: and it is evident, that this cause of the course of the shadow, is in it self a weaker cause, then the other of the course of light, and must give way unto it whensoever they encounter (as it can not be expected, but that in all circumstances, shadows should be light) because the colours which the glasse casteth in this case, are much more faint and dusky then in the other.

For effects of this latter cause; we see that when an opacous body lyeth crosse the prisme, whiles it standeth end-waies, the red or blew colour will appeare on the upper or lower side of its picture, according as the illuminant is higher or lower then the transverse opacous body: the blew ever keeping to that side of the picture, that is furthest from the body, and the illuminant that make it: and the red the contrary; likewise if an opacous body be placed out of the axis, in either of the cones we have explicated before, the blew will appeare on that side of the picture which is furthest advanced in the way that the shadow is cast: and the red, on the contrary: and so, if the opacous body be placed in the first cone (beside the axis) the red will appeare on that side of the picture in the basis of the second cone, which

is next to the circumference, and the blew, on that side, which is next the axis: but if it be placed on one side of the axis in the second cone, then the blew will appeare on that side the picture which is next the circumference; and the red, on that side, which is next the center of the basis of the cone.

2.
A difficult pro-
bleme resolved
touching the
prisme.

There remaineth yet one difficulty of moment to be determined: which is why, when through a glasse, two colours (namely, blew and red) are cast from a candle upon a paper or wall; if you put your eye in the place of one of the colours that shineth upon the wall, and so that colour commeth to shine upon your eye, in such sort that another man who looketh upon it, will see that colour plainly upon your eye, nevertheless, you shall see the other colour in the glasse? As for example, if on your eye there shineth a red, you shall see a blew in the glasse, and if a blew shineth upon your eye, you shall see a red.

The reason hereof is, that the colours which appeare in the glasse, are of the nature of those luminous colours which we first explicated, that arise from looking upon white and blacke bordering together: for a candle standing in the ayre, is as it were a white situated betweene two blackes: the circumstant dusky ayre, having the nature of a blacke: so then, that side of the candle which is seen through the thicker part of the glasse, appeareth red; and that which is seen through the thinner, appeareth blew: in the same manner as when we looke through the glasse; whereas, the colours shine contrarywise upon a paper or reflecting object, as we have already declared, together with the reasons of both these appearances; each fitted to its proper case, of looking through the glasse upon the luminous object surrounded with darknesse, in the one; and of observing the effect wrought by the same luminous object in some medium or upon some reflectent superficies, in the other.

And to confirme this, if a white paper be set standing hollow before the glasse (like halfe a hollow pillar, whose flat itandeth edgewaies towards the glasse, so as both the edges may be seen through it) the further edge will seem blew, and the neerer will be red; and the like will happen, if the paper be held in the free ayre parallell to the lower superficies of the glasse, without any blacke carpet to limit both ends of it (which serveth to make the colours the smarter) so that in both cases, the ayre serveth mani-
festly,

festly for a blacke ; in the first, betweene the two white edges ; and in the second, limiting the two white ends : and by consequence, the ayre about the candle must likewise serve for two blackes, including the light candle betweene them.

Severall other delightfull experiments of luminous colours I might produce, to confirme the grounds I have layd, for the nature and making of them. But I conceived that these I have mentioned, are abundantly enough for the end I propose unto my selfe : therefore I will take my leave of this supple and nice subject ; referring my Reader (if he be curious to entertaine himselfe with a full variety of such shining wonders) to our ingenious Countreyman, and my worthy friend, Mr. Hall : who at my last being at Liege, shewed me there most of the experiences I have mentioned ; together with severall other very fine and remarkable curiosities concerning light ; which he promised me he would shortly publish in a worke, that he had already cast and almost finished upon that subject : and in it, I doubt not but he will give entire satisfaction to all the doubts and Problems that may concur in this subject : whereas my little exercise formerly, in making experiments of this kind, and my lesse conveniency of attempting any now, maketh me content my selfe with thus spinning of a course thred from wooll carded me by others, that may runne through the whole doctrine of colours, whose causes have hitherto been so much admired : and that it will do so, I am strongly perswaded, both because if I look upon the causes which I have assigned *a priori*, me thinks they appeare very agreeable to nature and to reason ; and if I apply them to the severall Phnomens which Mr. Hall shewed me, and to as many others, as I have otherwise met with, I finde they agree exactly with them and render a full account of them.

And thus, you have the whole nature of luminous colours, resolved into the mixtion of light and darknesse : by the due ordering of which who have skill therein, may produce any middle colour he pleaseth : as I my selfe have seen the experience of infinite changes in such sort made ; so that it seemeth unto me, nothing can be more manifest, then that luminous colours are generated in the way that is here delivered. Of which how that gentle and obedient Philosophy of *Qualities* (readily obedient to what hard taske soever you assigne it) will render a ratioll account ;

account; and what discreet vertue, it will give the same things to produce different colours, and to make different appearances, meerely by such nice changes of situation. I do not well understand: but peradventure the Patrones of it, may say that every such circumstance is a *Conditio sine qua non*: and therewith (no doubt) their Auditors will be much the wiser in comprehending the particular nature of light, and of the colours that have their origine from it.

3.
Of the rain-
bow, and how
by the colour
of any body
we may know
the compositi-
on of the body
it selfe.

The Rainebow, for whose sake most men handle this matter of luminous colours, is generated in the first of the two waies we have delivered for the production of such colours: and hath its origine from refraction, when the eye being at a convenient distance from the refracting body, looketh upon it to discern what appeareth in it. The speculation of which may be found in that excellent discourse of Mounseur des Cartes, which is the sixt of his Meteors; where he hath with great accuratenesse delivered a most ingenious doctrine of this mystery: had not his bad chance of missing in a former principle (as I conceive) somewhat obscured it. For he there giveth the cause so neat, and so justly calculated to the appearances, as no man can doubt but that he hath found out the true reason of this wonder of nature, which hath perplexed so many great wits: as may almost be seen with our very eyes; when looking upon the fresh dew in a Sunshiny morning, we may in due positions perceive the rainbow colours, not three yards distant from us: in which we may distinguish even single drops with their effects. But he having determined the nature of light to consist in motion, and proceeding consequently, he concludeth colours to be but certaine kinds of motion; by which I feare it is impossible that any good account should be given of the experiences we see.

But what we have already said in that point, I conceive is sufficient to give the Reader satisfaction therein: and to secure him, that the generation of the colours in the rain-bow, as well as all other colours, is likewise reduced to the mingling of light and darknesse: which is our principall intent to prove: adding thereunto by way of advertisement, for others whose leisure may permit them to make use thereof, that who shall ballance the proportions of luminous colours, may peradventure make himselfe a step to judge of the natures of those bodies, which really

really and constantly doe weare like dyes; for, the figures of the least parts of such bodies, joyntly with the connexion or mingling of them with pores, must of necessity be that which maketh them reflect light unto our eyes, in such proportions, as the luminous colours of their tincture and semblance do.

For two things are to be considered in bodies, in order to reflecting of light: either the extancies and cavities of them; or their hardnesse and softnesse. As for the first; the proportions of light mingled with darknesse will be varied, according as the extancies or the cavities do exceed, and as each of them is great or small: since cavities have the nature of darknesse, in respect of extancies, as our moderne Astronomers do shew, when they give account of the face (as some call it) in the orbe of the Moone. Likewise in regard of soft or of resistant parts, light will be reflected by them, more or lesse strongly, that is, more or lesse mingled with darknesse; for whereas it reboundeth smartly backe, if it striketh upon a hard and a resistant body, and accordingly will shew it selfe in a bright colour: it must of necessity not reflect at all, or but very feebly, if it penetrateth into a body of much humidity, or if it looseth it selfe in the pores of it; and that little which commeth so weakely from it, must consequently appeare of a dusky die: and these two, being all the causes of the great variety of colours we see in bodies according to the quality of the body, in which the reall colour appeareth, it may easily be determined from which of them it proceedeth: and then by the colour, you may judge of the composition and mixture of the rare and dense parts, which by reflecting light begetteth it.

In fine, out of all we have hitherto said in this Chapter, we may conlude the primary intent of our so long discourse, which is, that as well the senses of living creatures, as the sensible qualities in bodies, are made by the mixtion of rarity and density, as well as the naturall qualities we spoke of in their place: for it cannot be denied but that heate and cold, and the other couples or paires, which beate upon our touch, are the very same as we see in other bodies: the qualities which move our taste and smell, are manifestly a kin and joyned with them: light we have concluded to be fire: and of motion (which affecteth our care) it is not disputable: so that it is evident, how all sensible qua-

4.
That all the sensible qualities are reall bodies resulting out of several mixtures of rarity and density.

lities,

qualities, are as truly bodies, as those other qualities which we call naturall.

To this we may adde, that the properties of these sensible qualities are such as proceed evidently from rarity and density; for (to omit those which our touch taketh notice of, as too plain to be questioned) Physitians judge and determine the naturall qualities of meats, and of medicines, and of simples by their tastes and smells: by those qualities they finde out powers in them to do materiall operations, and such as our instruments for cutting, filing, brushing, and the like, do unto ruder and grosser bodies. All which vertues, being in these instruments by the different tempers of rarity and density, is a convincing argument, that it must be the same causes, which must produce effects of the same kind in their smells and tastes: and as for light, it is known how corporeally it worketh upon our eyes.

Againe if we look particularly into the composition of the organs of our senses, we shall meet with nothing but such qualities as we finde in the composition of all other naturall bodies. If we search into our eye, we shall discover in it nothing but diaphaneity, softnesse, divers colours, and consistencies; which all Anatomists, to explicate, do parallell in other bodies: the like is of our tongue, our nosethrils, and our eares. As for our touch; that is so materall a sense, and so diffused over the whole body, we can have no difficulty about it. Seeing then that all the qualities we can discover in the organs of our senses, are made by the various minglings of rarity with density, how can we doubt, but that the active powers over these patients, must be of the same nature and kind?

Againe, seeing that examples above brought, doe convince, that the objects of one sense, may be known by another; who can doubt of a community among them, if not of degree, at the least of the whole kind? As we see that the touch, is the groundworke of all the rest; and consequently, that being evidently corporeall and consisting in a temper of rarity and density, why should we make difficulty in allowing the like of the rest?

Besides, let us compose of rarity and density, such tempers as, we finde in our senses; and let us againe compose of rarity and density, such actors, as we have determined the qualities, which we call sensible, to be; and will it not manifestly follow, that these

these two applied to one another, must produce such effects, as we affirme our senses have? that is, to passe the outward objects, by different degrees, unto an inward receiver.

Againe, let us cast our eyes upon the naturall resolution of bodies, and how they move us, and we shall thereby discover, both what the senses are, and why they are just so many, and that they cannot be more. For an outward body may move us, either in its owne hulke or quantity; or as it worketh upon another. The first is done by the touch, the second by the eare, when a body moving the ayre, maketh us take notice of his motion. Now in resolution, there are three active parts proceeding from a body, which have power to move us. The fiery part, which you see worketh upon our eyes, by the vertue of light. The ayrie part, which we know moveth our nosethrils, by being sucked in with the ayre. And lastly, the salt, which dissolveth in water, and so moveth our watry sense; which is our taste.

And these being all the active parts, that shew themselves in the resolution of a body; how can we imagine there should be any more senses to be wrought upon? for what the stable body sheweth of it selfe, will be reduced to the touch: what as it moveth, to hearing: what the resolutions of it, according to the natures of the resolved atomes that fly abroad; will concerne the other three senses, as we have declared. And more waies of working, or of active parts, we cannot conceive to spring out of the nature of a body.

Finally, if we cast our eyes upon the intention of nature: to what purpose are our senses, but to bring us into knowledge of the natures of the substances we converse withall? surely, to effect this, there cannot be invented a better, or more reasonable expedient, then to bring unto our judgement seate the likenesses or extracts of those substances, in so delicate a modell, that they may not be offensive or cumbersome; like so many patternes presented unto us, to know by them, what the whole piece is: for all similitude is a communication between two things in that quality, wherein their likenesse consisteth: and therefore we cannot doubt, but that nature hath given us by the means we have explicated, an essay to all the things in the world, that fall under our commerce, whereby of judge whether they be profitable or nocive unto us; and yet in so delicate and

Why the senses
are onely five
in number:
with a conclu-
sion of all the
former doctria
concerning
them.

subtile a quantity, as may in no waies be offensive to us, whiles we take our measures to attract what is good, and avoyd what is noxious.

THE TWO AND THIRTIETH CHAPTER.

Of sensation, or the motion whereby sense is properly exercised.

M^r.
Mounfieur des
Cartes his opi-
nion touching
sensation.

OUt of the considerations which we have delivered in these last Chapters, the Reader may gather the unreasonableness of vulgar Philosophers, who to explicate life and sense, are not content to give us termes without explicating them; but will force us to believe contradictions: telling us, that life consisted in this, that the same thing hath a power to worke upon it selfe: and that sensation, is a working of the active part of the same sense, upon its passive part; and yet will admit no parts in it: but will have the same indivisible power worke upon it selfe. And this, with such violence and downebearing of all opposition, that they deeme him not considerable in the schooles, who shall offer only to doubt of what they teach him hereabout; but brand him with the censure of one who knoweth not, and contradicteth the very first principles of Philosophy. And therefore, it is requisite we should looke somewhat more particularly into the manner how sensation is made.

Mounfieur des Cartes. (who by his great and heroike attempts, and by shewing mankind how to steere and husband their reason to best advantage, hath left us no excuse for being ignorant of any thing worth the knowing) explicating the nature of sense, is of opinion, that the bodies without us, in certaine circumstances, doe give a blow upon our exterior organes: from whence, by the continuity of the parts, that blow or motion is continued, till it come to our braine and seate of knowledge; upon which it giveth a stroke answerable to that, which the outward sense first received: and there this knocke causing a particular effect, according to the particular nature of the motion. (which dependeth of the nature of the object that produceth it) our soule and mind hath notice by this meanes, of every thing

thing that knocketh at our gates: and by the great variety of knocks or motions that our braine feeleth (which riseth from as great a variety of natures in the objects that cause them) we are enabled to judge of the nature and conditions of every thing we converse withall.

As for example: he conceiveth light to be nothing else but a percussion made by the illuminant upon the ayre, or upon the ethereall substance, which he putteth to be mixed with, and to runne through all bodies: which being a continueate medium between the illuminant and our sense; the percussion upon that, striketh also our sense; which he calleth the nerve that reacheth from the place stricken (to wit, from the bottome of our eye) unto the braine. Now, by reason of the continuity of this string or nerve, he conceiveth that the blow which is made upon the outward end of it by the ether, is conveyed by the other end of it to the braine; that end, striking the braine in the same measure as the ether stricke the other end of it: like the jacke of a Virginal, which striketh the sounding cord, according as the Musicians hand presseth upon the stop. The part of the braine which is thus stricken, he supposeth to be the fantasie, where he deemeth the soule doth reside; and thereby taketh notice of the motion and object that are without. And what is said thus of sight, is to be applied proportionably to the rest of the senses.

This then is the summe of Monsieur des Cartes his opinion, which he hath very finely expressed, with all the advantages that opposite examples, significant words, and cleare method can give unto a witty discourse. Which yet is but a part of the commendations he deserveth, for what he hath done on this particular. He is over and above all this, the first that I have ever met with, who hath published any conceptions of this nature, whereby to make the operations of sense intelligible. Certainly, this praise will ever belong unto him, that he hath given the first hint of speaking groundedly, and to the purpose upon this subject, and whosoever shall carry it any further (as what important mystery was ever borne and perfected at once?) must acknowledge to have derived his light from him.

For my part, I shall so farre agree with him as to allow motion

The Authors
opinion touch-
ing sensation.

tion alone to be sufficient to worke sensation in us: and not onely to allow it sufficient, but also to professe, that not onely this, but that no other effect whatsoever can be wrought in us, but motion, and by meanes of motion. Which is evident out of what we have already delivered, speaking of bodies in generall; that all action among them, either is locall motion, or else followeth it: and no lesse evident, out of what we have declared in particular, concerning the operations of the outward senses, and the objects that worke upon them: and therefore, whosoever shall in this matter, require any thing further then a difference of motion, he must first seeke other instruments in objects to cause it. For, examining from their very origine, the natures of all the bodies we converse withall; we cannot finde any ground to believe they have power or meanes to worke any thing beyond motion.

But I shall crave leave to differ from him, in determining what is the subject of this motion, whereby the braine judgeth of the nature of the thing that causeth it. He will allow no locall change of any thing in a man, further then certaine vibrations of strings, which he giveth the objects to play upon from the very sense up to the braine: and by their different manners of shaking the braine, he will have it know, what kind of thing it is that striketh the outward sense, without removing any thing within our body from one place to another. But I shall goe the more common way; and make the spirits to be the porters of all newes to the braine: onely adding thereunto that these newes which they carry thither, are materiall participations of the bodies, that worke upon the outward organes of the senses; and passing through them, do mingle themselves with the spirits, and so doe goe whither they carry them, that is, to the braine; unto which, from all parts of the body, they have immediate resort, and a perpetuall communcation with it.

So that, to exercise sense (which the Latines doe call *sensire*, but in English we have no one word common to our severall particular notions of divers perceptions by sense) is, *Our braine to receive an impression from the externe object by the operation or mediation of an organick part made for that purpose, and some one of those which we terme an externe sense, from which impression, usually floweth some motion proper to the living crea-*

ture. And thus you see that the outward senses, are not truly senses as if the power of sensation were in them: but in another meaning, to wit, so farre as they are instruments of qualifying or conveying the object to the braine.

Now, that the spirits are the instruments of this conveyance, is evident, by what we daily see, that if a man be very attentive to some one externe object (as to the hearing or seeing of something that much delighteth or displeaseth him) he neither heareth or seeth any thing but what his mind is bent upon; though all that while, his eyes and eares be open, and severall of their objects be present, which at other times would affect him. For what can be the reason of this, but that the braine employing the greatest part of his store of spirits about that one object, which so powerfully entertaineth him, the others find very few free for them to imbue with their tincture? And therefore, they have not strength enough to give the braine a sufficient taste of themselves, to make it be observed; nor to bring themselves into a place where they may be distinctly discerned: but striving to get unto it, they lose themselves in the throng of the others, who for that time doe besiege the braine closely. Whereas, in Monsieur des Cartes his way (in which no spirits are required) the apprehension must of necessity be carried precisely according to the force of the motion of the externe object.

This argument I confesse, is not so convincing a one against his opinion, but that the necessity of the consequence may be avoided; and another reason be given for this effect, in Mounseur des Cartes his doctrine: for he may say, that the affection being vehemently bent upon some one object, may cause the motion to be so violent by the addition of inward percussions; that the other comming from the outward sense, being weaker, may be drowned by it; as lesser sounds are by greater, which doe forcibly carry our eares their way, and doe fill them so entirely, that the others cannot get in to be heard: or as the drawing of one man that pulleth backwards, is not felt when a hundred draw forwards: Yet this is hard to conceive, considering the great eminency which the present object hath over an absent one; to make it self be felt: whence it followeth, that the multiplication of motion must be extremely increased within, to overtop

3.
Reasons to
perswade the
authors opi-
on.

and beare downe the motion, caused by a present object actually working without.

But that which indeed convinceth me to beleeve I goe not wrong in this course, which I have set downe for externe bodies working upon our sense and knowledge: is first, the convenience, and agreeableness to nature, both in the objects and in us; that it should be done in that manner: and next, a difficulty in Mounsieur des Cartes his way, which methinketh, maketh it impossible that his should be true. And then, his being absolutely the best of any I have hitherto met withall, and mine supplying what his falleth short in, and being sufficient to performe the effects we see: I shall not thinke I doe amisse in beleeving my owne to be true, till some body else shew a better.

4
That vitall
spirits are the
immediate
instruments of
sensation by
conveying
sensible qua-
lities to the
braine.

Let us examine these considerations one after another. It is manifest by what we have already established, that there is a perpetuall fluxe of little parts or atomes out of all sensible bodies; that are composed of the foure Elements, and are here in the sphere of continuall motion by action and passion: and such it is, that in all probability these little parts cannot chuse but get in at the doores of our bodies, and mingle themselves with the spirits that are in our nerves. Which if they doe, it is unavoydable, but that of necessity they must make some motion in the braine; as by the explication we have made of our outward senses, is manifest: and the braine being the source and origine of all such motion in the animal, as is termed voluntary; this stroke of the object; will have the power to cause some variation in its motions that are of that nature: and by consequence, must be a sensation; for, that change which being made in the braine by the object, is cause of voluntary motion in the animal, is that, which we call sensation.

But we shall have best satisfaction, by considering how it fa-
meth with every sense in particular. It is plain, that our touch or feeling is affected by the little bodies of heate, or cold, or the like; which are squeezed or evaporated from the object; and doe get into our flesh, and consequently, doe mingle themselves with our spirits: and accordingly, our hand is heated with the flood of subtile fire, which from a great one without, streameth into it: and is benumbed with multitudes of little bodies of cold, that settle in it. All which little bodies, of heate, or of cold

cold, or of what kind soever they be, when they are once got in, must needs mingle themselves with the spirits they meet with in the nerve: and consequently, must go along with them up to the braine: for the channell of the nerve being so little, that the most accurate inspectours of nature cannot distinguish any litle cavity or hole running along the substance of it: and the spirits which ebbe and flow in those channells, being so infinitely subtile, and in so small a quantity, as such channells can containe: it is evident, that an atome of insensible hignesse, is sufficient to imbue the whole length and quantity of spirit that is in one nerve: and that atome, by reason of the subtilty of the liquor it is immersed in, is presently and as it were instantly, diffused through the whole substance of it: the source therefore of that liquor being in the braine, it cannot be doubted, but that the force of the externe object must needs affect the braine according to the quality of the said atome: that is, give a motion, or knock, conformable to its owne nature.

As for our taste, it is as plaine, that the little parts expressed out of the body which affecteth it, doe mingle themselves with the liquor, that being in the tongue, is continuat to the spirits: and then, by our former argument it is evident, they must reach unto the braine. And for our smelling, there is nothing can hinder odours from having immediate passage up to our brain, when by our nose, they are once gotten into our head.

In our hearing, there is a little more difficulty: for sound being nothing but a motion of the Ayre, which striketh our eare; it may seem more then needeth, to send any corporeall substance into the braine: and that it is sufficient, that the vibrations of the outward aire, shaking the drumme of the eare, doe give a like motion to the ayre within the eare, that on the inside toucheth the tympane: and so this ayre thus moved, shaketh and beateth upon the braine. But this, I conceive, will not serve the turne; for if there were no more, but an equal motion, in the making of hearing; I doe not see, how sounds could be conserved in the memory: since of necessity, motion must alwayes reside in some body, which argument, wee shall presse anon, against Monsieur des Cartes his opinion for the rest of the senses.

5.
How sound
is conveyed
to the braine
by vitall
spirits.

Out of this difficulty, the very inspection of the parts within

the eare, seemeth to lead us : for had there been nothing necessary besides motion, the very striking of the outward ayre against the tympanum, would have been sufficient without any other particular and extraordinary organization, to have produced soundes, and to have carried their motions up to the braine : as wee see the head of a drumme bringeth the motions of the earth unto our eare, when we lay it thereunto, as we have formerly delivered. But Anatomists find other tooles and instruments, that seem fit to worke and forge bodies withall ; which we cannot imagine nature made in vaine. There is a hammer and an anvil : whereof the hammer, striking upon the anvil, must of necessity beate off such little parts of the brainy steames, as flying about, doe light and stick upon the top of the anvil : these by the trembling of the ayre following its course, cannot misse of being carried up to that part of the braine, whereunto the ayre within the eare is driven by the impulle of the sound : and as soon as they have given their knocke, they rebound back againe into the cells of the braine, fitted for harbours to such winged messengers : where they remaine lodged with quietnesse, till they be called for againe, to renew the effect which the sound did make at the first : and the various blowes which the hammer striketh, according to the various vibrations of the tympanum. (unto which the hammer is fastened ; and therefore is governed by its motions) must needs make great difference of bignesses, and cause great variety of smartnesses of motion, in the little bodies which they forge.

The last sense is of seeing ; whose action wee cannot doubt, is performed by the reflection of light unto our eye, from the bodies which we see : and this light commeth impregnated with a tincture drawne from the superficies of the object it is reflected from ; that is, it bringeth along with it, severall of the little atomes, which of themselves doe streame, and it cutteth from the body it struck upon, and reboundeth from ; and they, mingling themselves with the light, doe in company of it get into the eye : whose fabrick, is fit to gather and unite those species, as you may see by the anatomy of it ; and from the eye, their journey is but a short one to the braine : in which, wee cannot suspect that they should lose their force ; considering, how others that come from organes further off, doe conserve theirs :
and

How colours
are conveyed
to the braine
by vitall spi-
rits,

and likewise considering the nature of the optick spirits, which are conceived to be the most refined of all that are in mans body,

Now, that light is mingled with such little atomes issuing out of the bodies from which it is reflected; appeareth evidently enough, out of what we have Sayed, of the nature and operations of fire and light: and it seemeth to be confirmed, by what I have often observed in some chambers where people seldome come: which having their windows to the south, so as the sunne lyeth upon them a great part of the day in his greatest strength, and their curtaines being continually drawne over them, the glasse becomes dyed very deepe of the same colour the curtaine is of: which can proceed from no other cause, but that the beams which shoot through the glasse, being reflected back from the curtaine, doe take something along with them from the superficies of it; which being of a more solide corpulence then they, is left behind (as it were in the strainer) when they come to presse themselves through passages and pores, too little for it, to accompany them in: and so those atomes of colour, doe sticke upon the glasse, which they cannot penetrate.

Another confirmation of it is, that in certaine positions, the sunne reflecting from strong colours, will cast that very colour upon some other place; as I have often experienced in lively scarlet, and cloth of other smart colours: and this, not in that gloating wise, as it maketh colours of pure light, but like a true reall dye; and so, as the colour will appeare the same to a man, wheresoever he standeth.

Having thus shewed in all our senses, the conveniency and agreeablenesse of our opinion with nature; (which hath been deduced, out of the nature of the objects, the nature of our spirits, the nature and situation of our nerves, and lastly from the property of our braine:) our next consideration shall be, of the difficulty, that occurreth in Mr. des Cartes his opinion. First we know not how to reconcile the repugnancys appearing in his position of the motion of the ether; especially in light, for that Ethereal substance, being extreme rare, must perforce be either extreme liquid, or extreme brittle; if the first, it cannot choose but bow and be pressed into foulds, and bodies of unequall motions; swimming every where in it; and so it is impossible that it should bring unto the eye any constant apparition of the first mover.

7
Reasons against Monsieur des Cartes his opinion.

But let us suppose there were no such generall interruptions, every where encountering, and disturbing the conveyance of the first simple motion: yet, how can we conceive that a push, given so farre off, in so liquid an element, can continue its force so farre? We see that the greatest thunders and concussions, which at any time happen among us, cannot drive and impart their impulse the ten thousandth part of the vast distance, which the Sunne is removed from our eye; and can we imagine, that a little touch of that luminous body, should make an impression upon us, by moving another so extremely liquid and subtile, as the Ether is supposed; which like an immense Ocean, tossed with all varieties of motion, lyeth between it and us?

But admit there were no difficulty nor repugnance in the medium, to convey unto us a stroke, made upon it by the sunnes motion: let us at the least examine, what kinde of motions wee must allow in the sunne, to cause this effect. Certainly, it must needs be a motion towards us, or else it cannot strike and drive the medium forward, to make it strike upon us. And if it be so, either the sunne must perpetually be comming neerer and neerer to us; or else it must ever and anone be receding backwards, as well as moving forwards. Both which, are too chymericall for so great a wit to conceit.

Now, if the Ether be brittle, it must needs reflect upon every rubbe it meeteth with in its way, and must be broken and shivered by every body that moveth acrosse it: and therefore, must alwayes make an uncertaine and most disorderly percussion upon the eye.

Then againe; after it is arrived to the sense, it is no wayes likely it should be conveyed from thence to the braine, or that nature intended such a kind of instrument as a nerve, to continue a precise determinate motion: for if you consider how a lute string, or any other such medium conveyeth a motion made in it; you will finde, that to doe it well and clearly, it must be stretched throughout to its full extent, with a kinde of stiffnesse: whereas our nerves are not straight, but lie crooked in our body; and are very lither, till upon occasion spirits comming into them, doe swell them out. Besides, they are bound to flesh, and to other parts of the body; which being cessible, must needs dull the stroake, and not permit it to be carried farr. And lastly,

lastly, the nerves are subject to be at every turne contracted and dilated, upon their owne account, without any relation to the stroakes beating upon them from an externe agent: which is by no meanes, a convenient disposition for a body, that is to be the porter of any simple motion; which should alwayes lie watching in great quietnesse, to observe scrupulously, and exactly the errand hee is to carry: so that for my part, I cannot conceive, nature intended any such effect, by mediation of the sinews.

But Mounfieur des Cartes endeavoureth to confirme his opinion, by what useth to fall out in palsies, when a man loseth the strength of moving his hands, or other members, and nevertheless retaineth his feeling: which he imputeth to the remaining intire of the strings of the nerves, whiles the spirits are some way defective. To this we may answer, by producing examples of the contrary in some men, who have had the motion of their limbes intire and no wayes prejudiced, but have had no feeling at all, quite over their whole case of skinne and flesh: as particularly a servant in the Colledge of Physitians in London, whom the learned Harvey (one of his Masters) hath told me, was exceeding strong to labour, and very able to carry any necessary burthen, and to remove things dexterously, according to the occasion: and yet he was so voyde of feeling, that he used to grind his hands against the walls, and against course lumber, when he was employed to rummage any; in so much, that they would runne with blood, through grating of the skinne, without his feeling of what occasioned it.

In our way, the reason of both these conditions of people, (the paralytike, and the insensible) is easy to be rendred: for they proceed out of the divers disposition of the animal spirits in these parts: which if they thicken too much, and become very grosse, they are not capable of transmitting the fibrile messengers of the outward world, unto the tribunal of the braine, to judge of them. On the other side, if they be too subtil, they neither have, nor give power to swell the skin, and so to draw the muscles to their heads. And surely Mounfieur des Chartes taketh the wrong way, in the reason he giveth of the Palsie: for it proceedeth out of abundance of humours; which clogging the nerves, rendreth them washy, and maketh them lose their drynesse, and become lither, and consequently, unfit and unable, in his

8.

That the symptoms of the palsied oeno way confirme Mounfieur des Cartes his opinion.

his opinion; for sensation (which requireth stiffnesse) as well as for motion.

9.
That Moun-
seur des Cartes
his opinion,
cannot give a
good account,
how things are
conserved in
the memory.

Yet besides all these, one difficulty more remaineth against this doctrine, more insuperable (if I mistake not) then any thing, or all together wee have yet said: which is, how the memory should conserve any thing in it, and represent bodies to us; when our sense calleth for them, if nothing but motions do come into the braine. For it is impossible, that in so divisible a subject as the spirits, motion should be conserved any long time: as we see evidently in the ayre; through which move a flaming taper never so swiftly, and as soone as you set it down, almost in the very instant, the flame of it leaveth being driven or shaken on one side, and goeth quietly and evenly up its ordinary course: thereby shewing, that the motion of the ayre, which for the time was violent, is all of a suddaine quieted and at rest: for otherwise, the flame of the taper would blaze that way the Ayre were moved. Assuredly, the bodies that have power to conserve motion long, must be dry and hard ones. Nor yet can such conserve it very long, after the cause which made it, ceaseth from its operation. How then can we imagine, that such a multitude of pure motions, as the memory must be stored withall for the use and service of a man, can be kept on foote in his braine, without confusion; and for so long a time as his memory is able to extend unto? Consider a lesson plaid upon the Lute or Virginals; and think with your selfe, what power there is, or can be in nature, to conserve this lesson ever continually playing: and reflect, that if the impressions upon the common sense are nothing else but such things, then they must be actually conserved, alwaies actually moving in our head to the end they be immediatly produced, whensoever it pleaseth our will to call them.

And if peradventure it should be replied, that it is not necessary the motions themselves should alwaies be conserved in actuall being; but that it is sufficient there be certaine causes kept on foot in our heads, which are apt to reduce these motions into act, whensoever there is occasion of them: all I shall say hereunto is, that this is meerely a voluntary position, and that there appeareth no ground for these motions to make and constitute such causes; since we neither meet with any instru-
ments,

ments, nor discover any signes, whereby we may be induced to believe or understand any such operation.

It may be urged, that divers sounds are by diseases oftentimes made in our eares, and appearances of colours in our fantasie. But first, these colours and sounds, are not artificiall ones, and disposed and ordered by choice and judgement; for no story hath mentioned, that by a disease any man ever heard twenty verses of Virgill, or an ode of Horace in his eares: or that ever any man saw faire pictures in his fanly, by meanes of a blow given him upon his eye. And secondly, such colours and sounds as are objected, are nothing else, but (in the first case) the motion of humours in a mans eye by a blow upon it; which humours have the vertue of making light, in such sort as we see Sea-water hath, when it is clashed together: and (in the second case) a cold vapour in certaine parts of the braine, which causeth beatings or motion there; whence proceedeth the imitation of sounds: so that these examples do nothing advantage that party thence to infer that the similitudes of objects may be made in the common sense, without any reall bodies reserved for that end.

Yet I intend not to exclude motion from any commerce with the memory no more then I have done from sensation. For I will not only grant, that all our remembering is performed by the meanes of motion; but I will also acknowledge, that (in men) it is, for the most part, of nothing else but of motion. For what are words, but motion? And words are the chiefeft objects of our remembrance. It is true, we can, if we will, remember things in their owne shapes, as well as by the words that expresse them; but experience telleth us, that in our familiar conversation, and in the ordinary exercise of our memory, we remember and make use of the words, rather then of the things themselves.

Besides, the impressions which are made upon all our other senses, as well as upon our hearing, are likewise for the most part of things in motion; as if we have occasion to make a conception of a man, or of a horse, we ordinarily conceive him Walking, or Speaking, or Eating, or using some motion in time: and as these impressions are successively made upon the outward Organes; so are they successively carried into the fantasie, and

by

by like succession, are deliver'd over into the memory: from whence, when they are call'd back againe into the fantasie, they move likewise successively; so that in truth, all our memory will be of motion; or at the least, of bodies in motion: yet it is not chiefly of motion, but of the things that are mov'd; unlesse it be, when we remember words: and how those motions, do frame bodies which move in the braine, we have already touch'd.

THE THREE AND THIRTIETH CHAP.

Of Memory.

r.
How things
are conserv'd
in the memory

But how are these things conserv'd in the braine? And how do they revive in the fantasie, the same motions by which they came in thither at the first? Monsieur des Cartes hath put us in hope of an explication: and were I so happy, as to have seen that worke of his, which the World of learned men so much longeth for; I assure my selfe, I should herein receive great helpe and furtherance by it. Although withall, I must professe, I cannot understand how it is possible, that any determinate motion should long be preserv'd untainted in the braine; where there must be such a multitude of other motions in the way, to mingle with it, and bring all into confusion. One day I hope this jewell will be expos'd to publik view, both to do the Author right, and to instruct the World.

In the meane time, let us see what our own principles afford us. We have resolv'd, that sensation is not a pure driving of the animall spirits, or of some penetrable body in which they swim, against that part of the braine, where knowledge resideth: but that it is indeed the driving thither of solid materiall bodies (exceeding little ones) that come from the objects themselves. Which position, if it be true, it followeth that these bodies must rebound from thence upon other parts of the braine; where at the length they find some vacant cell, in which they keepe their ranks and files, in great quiet and order; all such sticking together, and keeping company with one another, that enter'd in together: and there they lye still
and

and are at rest, untill they be stirred up, either by the naturall appetite, (which is the ordinary course of beastes) or by chance, or by the will of the man in whom they are, upon the occasions he meeteth with of searching into them. Any of these three causes rayseth them up, and giveth them the motion that is proper to them; which is the same with that, whereby they came in at the first: for (as Galilaus teacheth us) every body hath a particular motion peculiarly proper to it, when nothing diverteth it: and then they slide successively, through the fantasie in the same manner, as when they presented themselves to it the first time. After which, if it require them no more; they returne gently to their quiet habitation in some other part of the braine, from whence they were called and summoned by the fantasies messengers, the spirits: but if it have longer use of them, and would view them better then once passing through permitteth; then they are turned back againe, and lead anew over their course, as often as is requisite: like a Horse, that a Rider paceth sundry times along by him that hee sheweth him to; whiles he is attentive to marke every part and motion in him.

But let us examine a little more particularly, how the causes we have assigned, do raise these bodies that rest in the memory, and do bring them to the fantasie. The middlemost of them (namely chance) needeth no looking into, because the principles that governe it, are uncertaine ones. But the first, and the last, (which are, the appetite, and the will) have a power (which we will explicate hereafter) of moving the braine and the nerves depending of it, conveniently and agreeably to their disposition. Out of which it followeth, that the little similitudes, which are in the caves of the braine wheeling and swimming about (almost in such sort, as you see in the washing of Currants or of Rice, by the winding about and circular turning of the Cookes hand) divers sorts of bodies do go their courses for a pretty while; so that the most ordinary objects cannot choose but present themselves quickly, because there are many of them, and are every where scattered about: but others that are fewer, are longer ere they come in view: much like as in a paire of beades, that containing more little ones then great ones; if you plucke to you the string they all hang

2.
How things
conserved in
the memory are
brought backe
into the fan-
tasie.

upon,

upon, you shall meete with many more of one sort, then of the other.

Now, as soone as the braine hath lighted on any of those it seeketh for, it putteth as it were a stop upon the motion of that; or at the least, it moveth it so, that it goeth not far away, and is revocable at will: and seemeth like a baite to draw into the fantasie others belonging unto the same thing, either through similitude of nature, or by their connexion in the impressiō: and by this meanes hindereth other objects, not pertinent to the work the fanſie hath in hand, from offering themselves unseasonably in the multitudes that otherwise they would do. But if the fanſie should have mistaken one object for an other, by reason of some resemblance they have between themselves; then it shaketh againe the liquid medium they all floate in, and rooſeth every species lurking in remotest corners, and runneth over the whole beadroule of them: and continueth this inquisition and motion, till either it be satisfied with retrieving at length what it required, or that it be growne weary with tossing about the multitude of little inhabitants in its numerous empire, and so giveth over the search, unwillingly and displeasidly.

^{3.}
A Confirmation
of the former
doctrine.

Now, that these things be as we have declared, will appeare out of the following considerations; first, we see that things of quite different natures, if they come in together, are remembered together: upon which principle the whole art of memory dependeth: such things cannot any way be comprised under certaine heads, nor be linked together by order and consequence, or by any resemblance to one another: and therefore all their connexion must be, that as they came in together into the fantasie, so they remaine together in the same place in the memory: and their first coupling must proceed from the action that bound them together, in driving them in together.

Next, we may observe, that when a man seeketh and tumbleth in his memory for any thing he would retrieve, he hath first some common and confused notion of it: and sometimes he hath a kind of flasing or fading likeneſſe of it: much what, as when in striving to remember a Name, men use to say, it is at their tongues end: and this sheweth, that he attracteth those things he desireth, and hath use of, by the likeneſſe of something

thing belonging to them. In like manner, when hunger maketh one think of meat, or thirst maketh one dreame of drink, or in other such occasions, wherein the naturall appetite stirreth objects in the memory and bringeth them to the fantasie; it is manifest, that the spirits informing the braine of the defect and paine, which severall parts of the body do endure, for want of their due nourishment; it giveth a motion to the heart, which sendeth other spirits up to supply the braine, for what service it will order them: by which, the braine being fortified, it followeth the pursuite of what the living creature is in want of; untill the dis tempered parts be reduced into their due state by a more solid enjoying of it.

Now, why objects that are drawn out of the memory, do use to appeare in the fantasie, with all the same circumstances which accompanied them at the time when the sense did send them thither, (as when in the remembrance of a friend we consider him in some place, and at a certaine time, and doing some determinate action) the reason is, that the same body, being in the same medium, must necessarily have the same kind of motion; and so consequently, must make the same impression upon the same subject. The medium which these bodies move in (that is, the memory) is a liquid vaporous substance, in which they floate and swim at liberty.

Now, in such a kind of medium, all the bodies that are of one nature, will easily gather together, if nothing disturbe them: for as when a tuned Lute string is stricken, that string by communicating a determinate species of vibration to the Ayre round about it, shaketh other strings, within the compasse of the moved ayre; not all, of what extent soever, but onely such, as by their naturall motion, would cause like curlings, and fouldes in the Ayre, as the other doth; according to what Galileus hath at large declared: even so, when some atome in the braine is moved, all the rest there about, which are apt to be wafted with a like undulation, must needs be moved in chiefe: and so they moving, whiles the others of different motions, that having nothing to rayle them, do either ly quiet or move very little in respect of the former; it is no wonder if they assemble together, and (by the proper course of the braine) do meet at the common rendezvous of the fantasie.

How things renewed in the fantasie, returne with the same circumstances that they had at first

5.

How the memory of things past is lost, or confounded; and how it is repaired & gaind.

And therefore the more impressions, that are made from the same object upon the sense, the more participations of it will be gathered together in the memory: and the stronger impressions, it will upon occasion make in the fantasie: and themselves will be the stronger to resist any cause that shall strive to deface them. For we see that multitude of objects overwhelmeth the memory; and putteth out, or at the least, maketh unprofitable, those that are seldome thought on. The reason of which is, that they being little in quantity, because there are but few species of them; they can never strike the seate of knowledge, but in company of others; which being more and greater, doe make the impression follow their nature against the lesser: and in tract of time, things seldome thought of, doe grow to have but a maimed and confused shape in the memory; and at length are quite forgotten. Which happeneth, because in the liquid medium, they are apt to moulder away, if they be not often repaired: which mouldring and defacing, is helped on by the shocks they receive from other bodies: like as in a magazin, a ching that were not regarded, but were carelessly tumbled up and downe, to make roome for others, and all things were promiscuously throwne upon it; it would soone be bruised and crushed into a mishapen forme, and in the end be broken all in pieces.

Now, the repairing of any thing in the memory, is done, by receiving new impressions from the object; or in its absence, by thinking strongly of it: which is an assembling, and due peeing together of the severall particles of bodies, appertaining to the same matter. But sometimes it happeneth, that when the right one cannot be found intire, nor all the orderly pieces of it, be retrieved with their just correspondence to one another; the fantasie maketh up a new one in the place of it: which (afterwards, upon presence of the object, appeareth to have beene mistaken: and yet the memory, till then, keepeth quietly and unquestionedly for the true object, what either, the thought, or chance, mingling severall parts, had patched up together.

And from hence, we may discern, how, the loosing or confounding of ones memory, may happen either by sicknesses, that distemper the spirits in the braine, & disorder their motions, or by
some

Some blowes on the head, whereby a man is astonied, and all things seeme to turne round with him. Of all which effects, the causes are easy to be found in these suppositions wee have layed.

THE FOURE AND THIRTIETH CHAP.

Of voluntary motion, Naturall faculties, and passions.

Hitherto we have laboured to convery the object into the braine : but when it is there, let us see what further effects it causeth : and how that action, which we call *voluntary motion*, doth proceed from the braine. For the discovery whereof, we are to note, that the braine is a substance composed of watry parts mingled with earthy ones : which kind of substances we see are usually full of strings : and so in strong hard beere, and in vinegar, and in other liquors of the like nature, we see (if they be exposed to the Sunne) little long flakes, which make an appearance of Wormes or Maggats floating about. The reason whereof is, that some dry parts of such liquors are of themselves as it were hairy or fleshy, that is, have little downy parts, such as you see upon the legs of Flies, or upon Caterpillars, or in little locks of wooll ; by which they easily catch and stick to the other little parts of the like nature, that come neer unto them : and if the liquor be moved, (as it is in the boyling of beere, or making of vinegar by the heate of the Sun) they become long strings ; because the liquor breaketh the ties which are crosse to its motion : but such as lie along the streame, or rather the bubling up, do maintaine themselves in unity, and peradventure grow stronger, by the winding or foulding of the end of one part with an other : and in their tumbling and rouling still in the same course, the downy haire are crushed in, and the body groweth long and round, as happeneth to a lump of dough, or wax, or wooll, rouled a while in one uniform course. And so, coming to our purpose, we see that the braine and all that is made of it, is stringy ; witnessse, the membranes, the flesh, the bones, &c. But of all the rest, those which be called fibers, are most stringy ; and the nerves seem to be but an

¶ Of what matter the braine is composed.

assembly of them: for although the nerves be but a great multitude of strings lying in a cluster; nevertheless, by the consent of Physicians and Anatomistes, they are held to be of the very substance of the braine, dried to a firmer consistence then it is in the head.

This heape of strings (as wee may call it) is enclosed in an outside made of membranes; whose frame, wee need not here display: only we may note, that it is very apt and fit to stretch; and after stretching, to returne againe to its owne just length. Next, we are to consider, how the braine is of a nature apt to swell and to sinke againe: even so much, that Fallopius reporteth, it doth swell according to the encrease of the moone: which whether it be true or no; there can be no doubt, but that it being of a substance which is full of skinnes and strings, is capable of being stretched, and of swelling upon light occasions; and of falling or sinking againe upon as light as being easily penetrable by vapours and by liquors, whose nature it is, to swell and to extend that which they enter into. Out of which it followeth, that it must be the nature of the nerves to doe the like: and indeed, so much the more, by how much more dry they are then the braine: for wee see that (to a certain measure) drier things are more capable of extension by the ingression of wet, then moyst things are; because these are not capable of receiving much more wet into them.

2
What is voluntary motion.

These things being premised; let us imagine that the braine being first swelled, it doth afterwards contract it self; and it must of necessity follow, that seeing the nerves are all open towards the braine (though their concavities cannot be discerned) the spirits and moyllure which are in the braine, must needs be pressed into the nerves: which being already stored with spirits, sufficiently to the proportion of their hard skinnes; this addition will make them swell and grow hard, as a ballloone doth, which being competently full of ayre, hath nevertheless more ayre pressed into it.

Since therefore, the masters of Anatomy doe teach us, that in every muscle there is a nerve, which is spread into a number of little branches along that muscle; it must follow, that if these little branches be swollen, the flesh likewise of that muscle must also needs be swollen. Now the muscle having both its endes fastened,

fastened, the one in a greater bone, the other in a lesser; and there being least resistance on that part, where the bone is lesser, and more moveable; the swelling of the muscle cannot choose, but draw the little bone towards the great one; and by consequence, move that little bone: and this is that, which Philosophers usually call *Voluntary motion*: for since our knowledge remaineth in the braine, whatsoever is done by knowledge, must be done by the braine; and most of what the braine worketh for the common service of the living creature, proceedeth also from knowledge; that is, from the motion of the fancy, which we have expressed.

This matter being thus far declared, we may now enter upon the explication of certaine effects; which peradventure might have challenged roome, in the precedent Chapter; but indeed, could not well be handled without first supposing this last discourse: and it is, what is meant by those powers, that are called naturall faculties: the which howsoever in their particulars they be manifold in a living creature, yet whensoever any of them is resolved, it appeareth to be compounded of some of these five; to wit, the attractive, the retentive, the secretive the concoctive, and the expulsive faculty.

Of which, the attractive, the secretive, and the concoctive do not seeme to belong unto the nerves, for although we may conceive that the part of the animall doth turne it selfe towards the thing which it attracteth; neverthelesse, that very turning seemeth not to be done by vertue of the muscles, and of the nerves, but rather in a naturall way, as the motion of the heart is performed, in such sort as we have formerly declared: as for example, if the stomach when it is greedy of meate, draweth it selfe up towards the throate, it seemeth rather to be a kind of drynesse and of warping, such as we see in bladders or in leather either by fire or by cold, which make them shrivell up and grow hard; then that it is a true faculty of the living creature to seeke after meate.

Nor need we extend our discourse any further about these three faculties; seeing that we have already declared in common, how attraction, drying, and mixture of active bodies with passive ones, is performed; which needeth but applying unto these particulars; to explicate fully their natures: as for example;

3.
What those powers are which are called naturall faculties.

4.
How the attractive and secretive faculties worke.

if the Kidneyes draw the matter of Urine unto them out of the Veines, it may be by any of the following three manners, to wit, either by draught, wet, or by steame. For if the serous parts that are in the blood which runneth in the Veines, do touch some dry parts conformable to their nature, tending towards the Kidneyes; they will infallibly adhere more to those dry parts, then to the rest of the blood. Which if they do in so great a quantity, that they reach to other further parts more dry then these, they will leave the first parts to go to the second: and thus by little, and little, will draw a line of Urine from the blood, if the blood do abound with it: and the neerer it commeth to the Kidneyes, the stronger still the attraction will be.

The like will happen, if the serosity which is in the blood, do touch some part wetted with a like serosity, or where such hath lately passed; for as we see that water will run more easily upon a wet part of a board or a stone then upon a dry one; so you cannot doubt, but that if the serous part, which is mixed with the blood, do light upon a current of its own nature, it will stick more to that, then to the current of the blood; and so part from the blood, to goe that way which the current of its own nature goeth.

Besides, it cannot be doubted, but that from the Kidneyes; and from the passages between the Kidneys and the Veines, in which the blood is conveyed, there ariseth a steame: whose nature is, to incorporate it selfe with serous matter, out of whose body it hath been extracted. This steame therefore, flying still to the serous blood which passeth by, must of necessity precipitate (as I may say) the serous parts of that blood; or rather must filter them out of their maine steck; and so will make them run in that current, from which it selfe doth flow. And thus you see how *Attraction* and *Secresion* are made: for the drawing of the serosity without drawing the blood, is the parting of the Urine from the blood. And this example, of the Kidneyes operation, may be applyed to the attractions of all the other parts.

5. Concerning the concoctive faculty. Now the concoctive faculty (which is the last of the three we took together) consisteth of two parts: the one is, as it were a drying of the humour, which is to be concocted; the other is,

a mingling the substance of the vessell in which the humour is concocted, with the humour it selfe : for as if you boyle divers kinds of liquors in brasse pannes, the pannes will taynt the liquor with the quality of the brasse ; and therefore Physitians forbid the use of such, in the boyling of severall medicines : so much more in a living creatures body, there can be no doubt, but that the vessell in which any humour is concocted, doth give a tincture thereunto. Now concoction consistig in these two, it is evident, what the concoctive vertue is; to wit, heate, and the specifical property of the vessell which by heate is mingled with the humour.

There remaine yet, the retentive and the expulsive faculties to be discoursed of; whereof one kind, is manifestly belonging to the voluntary motion which we have declared : namely that retention, and that expulsion, which we ordinarily make of the grosse excrements either of meate, or of drinke, or of other humours, either from our head, or from our stomacke, or from our Lungs ; for it is manifestly done, partly by taking in of winde, and partly by compressing of some parts and opening of others : as Galen sheweth in his curious book *de usu partium*.

An other kind of retention and expulsion : in which we have no sense when it is made (or if we have, it is of a thing done in us without our will, though peradventure we may voluntarily advance it) is made by the swelling of fibers in certaine parts, through the confluence of humours to them, (as in our stomack it happeneth, by the drink and the juice of the meate that is in it) which swelling, closeth up the passages by which the contained substance should go out (as the moystening of the strings, and mouth of a purse, almost shutteth it) untill in some (for example, the stomack, after a meale) the humour being attenuated by little and little, getteth out subtilly ; and so leaving lesse weight in the stomack, the bag which weigheth down lower, then the neather Orifice at which the digested meate issueth, riseth a little : and this rising of it is also furthered by the wrinkling up and shortning of the upper part of the stomack ; which still rerurneth into its naturall corrugation, as the masse of liquid meate leaveth soaking it (which it doth by degrees, still as more and more goeth out ; and so what remaineth filleth lesse place,

6.
Concerning
the retentive
and expulsive
faculties

and reacheth not so high of the stomacke : and thus at length, the residue and thicker substance of the meat, after the thinnest is got out in steame, and the middling part is boyled over in liquor, commeth to presse and gravitate wholly upon the orifice of the stomacke ; which being then helped by the figure and lying of the rest of the stomacke, and its strings and mouth relaxing, by having the juice which swelled them, squeezed out of them ; it openeth it selfe, and giveth way unto that which lay so heavy upon it, to tumble out. In others (for example, in a woman with child) the enclosed substance, (retained first by such a course of nature as we have set down) breaketh it selfe a passage by force, and openeth the orifice at which it is to goe out by violence, when all circumstances are ripe according to natures institution.

7.
Concerning
expulsion made
by Physicke.

But yet there is the expulsion which is made by physicke, that requireth a little declaration. It is of five kinds: vomiting, purging by stooles, by urine, sweating, and salivation. Every one of which, seemeth to consist of two parts, namely, the disposition of the thing to be purged, and the motion of the nerves or fibers for the expulsion: as for example, when the Physitian giveth a purge, it worketh two things: the one is, to make some certaine humour more liquid and purgeable then the rest; the other is, to make the stomacke or belly, sucke or vent this humour. For the first, the property of the purge must be to precipitate that humour out of the rest of the blood; or if it be thicke, to dissolve it that it may runne easily. For the second, it ordinarily heateth the stomacke; and by that meanes it causeth the stomacke to sucke out of the veines, and so to draw from all parts of the body. Besides this, it ordinarily filleth the belly with winde, which occasioneth those gripings men feele when they take physick; and is cause of the guts discharging those humours, which otherwise they would retaine.

The like of this happened in salivation; for the humours are by the same means brought to the stomack, and thence sublimed up to be spitten out: as we see in those, who taking Mercury into their body, either in substance or in smoke, or by application, doe vent cold humours from any part; the Mercury rising from all the body up to the mouth of the patient, as to the helm

of a sublimary: and the like some say of Tobacco.

As for vomiting, it is in a manner wholly the operation of the fibers, provoked by the feeling of some inconvenient body, which maketh the stomacke wrinkle it selfe, and work and strive to cast out what offendeth it.

Sweating seemeth to be caused, by the heating of some in-
trous body by the stomacke; which being of subtile parts, is by
heat disperfed from the middle to the circumference; and carri-
eth with it light humours, which turne into water as they come
out into the ayre. And thus you see in generall, and as much as
concerneth us to declare, what the naturall faculties are: and this,
according to Galen his owne mind: who affirmeth, that these
faculties do follow the complexion, or the temper of the parts of
a mans body.

Having explicated how voluntary motion proceedeth from
the braine: our next consideration ought to be, to examine what
it is, that such an object, as we brought, by meanes of the senses,
into the braine from without, doth contribute to make the
braine apply it selfe to worke such voluntary motion. To which
purpose, we will goe a step or two backe, to meet the object at its
entrance into the sense; and from thence accompany it in all its
journey and motions onwards. The object which striketh at
the senses dore, and getting in, mingleth it selfe with the spi-
rits it findeth there; is either conforme and agreeable to the
nature and temper of those spirits, or it is not: that is to say,
in short, it is either pleasing or displeasing to the living creature:
or it may be of a third kind, which being neither of these, we
may terme indifferent. In which sort soever the object affect
the sense, the spirits carry it immediately to the braine, unlesse
some distemper or strong thought, or other accident hinder
them.

Now, if the object be of the third kind; that is, be indis-
ferent; as soone as it hath stricken the braine, it reboundeth
to the circle of the memory: and there, being speedily joy-
ned to others of its owne nature, it findeth them annexed to
some pleasing or displeasing thing, or it doth not: if not, in
beasts it serveth to little use: and in men, it remaineth there
untill it be called for: but if, either in its owne nature, it
be pleasing or displeasing; or afterwards in the memory it
became.

8

How the brain
is moved to
worke volun-
tary motion.

became joynd to some pleasing or annoying fellowship; presently, the heart is sensible of it: for the heart being joynd to the braine by straight and large nerves, full of strong spirits which ascend from the heart; it is impossible, but that it must have some communication with those motions, which passe in the braine: upon which the heart, or rather the spirits about it, is either dilated or compressed.

And these motions, may be either totally of one kind, or moderated, and allayed by the mixture of its contrary: if of the former sort; one of them wee call *joy*, the other *griefe*; which doe continue about the heart (and peradventure doe oppresse it, if they bee in the utmost extremity) without sending any due proportion of spirits to the braine, untill they settle a little, and grow more moderate.

Now, when these motions are moderate, they immediately send up some abundance of spirits to the braine: which if they be in a convenient proportion, they are by the braine thrust into such nerves as are fit to receive them: and swelling them, they give motion to the muscles and tendons that are fastned to them: and they doe move the whole body, or what part of it is under command of those nerves, that are thus filled and swelled with spirits by the braine.

If the object was conformable to the living creature, then the braine sendeth spirits into such nerves, as carry the body to it: but if otherwise, it causeth a motion of aversion or flight from it. To the cause of this latter, we give the name of *Fears*: and the other, that carrieth one to the pursuit of the object, we call *Hope*. *Anger*, or *Audacity*, is mixed of both these; for it seeketh to avoide an evill by embracing and overcoming it: and proceedeth out of abundance of spirits.

Now, if the proportion of spirits sent from the heart, be too great for the braine, it hindereth or perverteth the due operation both in man and beast.

9.
Why pleasing
objects do dilate the spirits
and displeasing
ones contract
them.

All which it will not be amisse to open a little more particularly: and first, why painfull or displeasing objects, doe contract the spirits, and gratefull ones, doe contrarywise dilate them? It is, because the good of the heart consisteth in life, that is in heat & moisture: and it is the nature of heat, to dilate it self

in moyſture; whereas cold and dry things, doe contract the bodies they worke upon: and ſuch are enemies to the nature of men and beaſts: and accordingly experience, as well as reaſon, teacheth us, that all objects, which be naturally good, are ſuch as be hot and moyſt in the due proportion to the creature that is affected and pleaſed with them.

Now, the living creature being compoſed of the ſame principles as the world round about him is; and the heart being an abridgement of the whole ſenſible creature; and being moreover full of blood, and that very hot; it commeth to paſſe, that if any of theſe little extracts of the outward world, doe arrive to the hot blood about the heart, it worketh in this blood ſuch like an effect, as we ſee a drop of water falling into a glaſſe of wine, which is preſently diſperſed into a competent compaſſe of the wine: ſo that any little object muſt needs make a notable motion in the blood about the heart.

This motion, according to the nature of the object, will be either conformable or contrary; unleſſe it be ſo little a one, as no effect will follow of it; and then, it is of that kinde, which above we called indifferent. If the enſuing effect be connaturall to the heart, there riſeth a motion of a certaine fume about the heart; which motion we call *pleaſure*; and it never fayleth of accompanying all thoſe motions which are good, as *Joy, Love, Hope* and the like: but if the motion be diſpleaſing; there is likewiſe a common ſenſe of a heavineſſe about the heart, which we call *griefe*: and it is common to *ſorrow, feare, hate*, and the like.

Now it is manifeſt by experience, that theſe motions are all of them different ones, and doe ſtrike againſt divers of thoſe parts of our body which encompaſſe the heart: out of which ſtriking followeth that the ſpirits ſent from the heart, doe affect the braine diverſly; and are by it it, conveyed into divers nerves: and ſo doe ſet divers members in action. Whence followeth, that certaine members are generally moved upon the motion of ſuch a paſſion in the heart, eſpecially in beaſtes; who have a more determinate courſe of working, then man hath: and if ſometimes wee ſee variety, even in beaſtes; upon knowledge of the circumſtances, wee may eaſily gueſſe at the cauſes of that variety: the particularities

rities of all which motions, we remit to Physicians and to Anatomists : advertising onely, that the fume of pleasure, and the heaviness of griefe, doe plainly shew, that the first motions doe participate of dilatation, and the latter of compression.

10
Concerning
the five senses
of what use and
end they are.

Thus you see, how by the senses, a living creature becommeth judge of what is good, and of what is bad for him : which operation, is performed more perfectly in beasts ; and especially in those, who live in the free ayre, remote from humane conversation (for their senses are fresh and untaynted, as nature made them) then in men. Yet without doubt nature hath been as favourable in this particular to men, as unto them : were it not, that with disorder and excesse, we corrupt and oppresse our senses : as appeareth evidently by the story we have recorded of John of Leige : as also by the ordinary practice of some Hermites in the deserts, who by their taste or smell, would presently be informed whether the herbes, and roots, and fruits they met withall, were good or hurtful for them, though they never before had had triall of them.

Of which excellency of the senses, there remaineth in us onely some dimme sparkes ; in those qualities which we call sympathies and antipathies : whereof the reasons are plaine, out of our late discourse : and are nothing else, but a conformity or opposition of a living creature, by some individuall property of it, unto some body without it : in such sort, as its conformity or opposition unto things by its specifiall qualities, is termed naturall or against nature. But of this we shall discourse more at large hereafter.

Thus it appeareth, how the senses are seated in us, principally for the end of moving us to, or from objects, that are good for us, or hurtfull to us. But though our Reader be content to allow this intent of nature, in our three inferiour senses ; yet he may peradventure not be satisfied ; how the two more noble ones (the hearing and the seeing) doe cause such motions to, or from objects, as are requisite to be in living creatures for the preservation of them : for (may he say) how can a man, by onely seeing an object, or by hearing the sound of it, tell what qualities it is imbued withall ? Or what motion of liking or disliking, can be caused in his heart, by his meeere receiving the visible

ble species of an object at his eyes, or by his eares hearing some noise it maketh? And if there be no such motion there; what should occasion him, to prosecute or avoyd that object? When he tasteth, or smelleth, or toucheth a thing, he findeth it sweet, or bitter, or stinking, or hot, or cold; and is therewith either pleased or displeas'd; but when he onely seeth or heareth it, what liking or disliking can he have of it, in order to the preservation of his nature?

The solution of this difficulty, may in part appeare out of what we have already said. But for the most part, the objects of these two nobler senses doe move us, by being joyned in the memory with some other thing that did either please or displeas'e some of the other three senses. And from thence it is, that the motion of going to imbrace the object, or aversion from it, doth immediately proceed: as when a dog seeth a man that useth to give him meat, the species of the man coming into his fansie, calleth out of his memory the others which are of the same nature, and are former participations of that man; as well as this fresh one is: but these are joyned with specieses of meate, because at other times they did use to come in together: and therefore the meate being a good unto him; and causing him (in the manner we have said) to move towards it; it will follow that the dog will presently move towards that man, and expresse a contentednesse in being with him. And this is the ground of all assuefaction in beasts, and of making them capable of receiving any instructions.

THE FIVE AND THIRTIETH CHAPTER.

Of the materiall instruments of Knowledge and Passion; of the severall effects of Passions; of Paine and Pleasure; and how the vitall Spirits are sent from the brain into the intended parts of the body, without mistaking their way.

TO conclude this great businesse, which concerneth all the mutations and motions, that are made by outward Agents in a living creature, it will not be amisse, to take a short and generall survey of the materiall instruments, which

concur

That *Septum Lucidum* is the seat of the faculty.

concur to this effect. Whereof the braine being the principall, or at least, the first and next of the principals; we may take notice that it containeth, towards the middle of its substance, foure concavities, as some doe count then: but in truth, these foure, are but one great concavity, in which foure, as it were, divers roomes, may be distinguished. The neather part of these concavities, is very unequal, having joyned unto it, a kind of net, wrought by the entangling of certain little arteries, and of small emanations from a *Sinus*, which are interwoven together. Besides this, it is full of kernels, which do make it yet more uneven.

Now, two rooms of this great concavity, are divided by a little body, somewhat like a skin, (though more fryable) which of it selfe is cleare; but there it is somewhat dimmed, by reason that hanging a little flacke, it somewhat shriveleth together: and this, Anatomists do call *Septum lucidum*, or *speculum*; and is an indifferent body from all the rest that are in the braine. This transparent body hangeth as it were straightwards from the forehead towards the hinder part of the head: and divideth the hollow of the brain, as far as it reacheth, into the right and the left ventricles.

This part seemeth to me, (after weighing all circumstances and considering all the conveniences, and fitnesses) to be that, and onely that, in which the fanse or common sense resideth: though Monsieur des Cartes hath rather chosen a kernell to place it in. The reasons of my assertions are; first, that it is in the middle of the braine, which is the most convenient situation to receive the messages from all our body, that doe come by nerves, some from before, and some from behind. Secondly, that with its two sides, it seemeth to be conveniently opposed to all such of our senses, as are double; the one of them sending its little messengers or atomes, to give it advertisements on one side, the other on the other side; so that it is capable of receiving impression indifferently from both. Againe, by the nature of the body, it seemeth more fit to receive all differences of motion, then any other body neer it. It is also most conformable to the nature of the eye; which being our principal outward sense must needs be in the next degre to that, which is elevated a strain above our outward senses. Fifthly, it is of a single and peculiar nature, whereas the kernels are many, and all of them of the same

condition, quality, and appearance. Sixtly, it is seated in the very hollow of the braine; which of necessity must be the place and receptacle where the specieses and similitudes of things doe reside; and where they are moved and tumbled up and down, when we think of many things. And lastly, the situation wee put our head in, when we think earnestly of any thing, favoureth this opinion: for then we hang our head forwards, as it were forcing the specieses to settle towards our forehead, that from thence they may rebound, and worke upon this diaphanous substance.

This then supposed, let us consider, that the atomes or likenesses of bodies, having given their touch upon this *Septum* or *Speculum*, doe thence retire back into the concavities, and doe sticke (as by chance it happeneth) in some of the inequalities they encounter with there. But if some winde or forcible steame, should breake into these caves, and as it were brush and sweepe them over; it must follow, that these little bodies wil loosen themselves, and begin to play in the vapour which filleth this hollow place: and so floating up and down, come anew to strike and worke upon the *Speculum* or fantasy: which being also a soluble body, many times these atomes striking upon it, do carry some little corporeall substance from it sticking upon them: whence ensueth, that they returning again with those tinctures or participations of the very substance of the fantasy; do make us remember, not only the objects themselves, but also that wee have thought of them before.

Further we are to know, that all the nerves of the braine, have their beginnings not farre from this *speculum*: of which we shall take a more particular consideration of two, that are called the sixt paire or couple: which pair hath his singularity, that it beginneth in a great many little branches, that presently grow together, and make two great ones contained within one skin. Now this being the property of a sense (which requireth to have many fibers in it, to the end that it may be easily and vigorously stricken, by many parts of the object lighting upon many parts of those little fibers;) it giveth us to understand, that this sixt couple hath a particular nature, conformable to the nature of an externe sense, and that the Architect who placed it there, intended by the severall conduits of it, to give notice unto some part they goe unto, of what passeth in the braine: and accordingly

2.
What causeth us to remember not only the object it self, but also that we have thought of it before.

3.
How the motions of the fantastic, are derived to the heart.

dingly one branch of this nerve, reacheth to the heart; not only to the Pericardium, as Galen thought, but even to the very substance of the heart it self, as later Anatomists have discovered: by which we plainly see how the motion which the senses doe make in the *Speculum*, may be derived downe to the heart.

4
Of paine and
pleasur.

Now therefore let us consider, what effects the motions so conveyed from the braine, will worke in the heart. First remembering how all that moveth the heart, is either paine or pleasure (though we doe not use to call it paine, but grief, when the evill of sense moveth us only by memory, and not by being actually in the sense) and then calling to minde, how paine (as Naturalistes teach us) consisteth in some division of a nerve, (which they call *Solutio continui*: and must be in a nerve; for that no solution can be the cause of paine, without sense, nor sense be without nerves; and therefore this solution must needs be in nerves, to have it prove painfull,) we may conclude, that the effect which we call paine, is nothing else but a compression: for although this solution of continuity may seeme to be a dilatation; yet in truth, it is a compression in the part where the evill is, which happeneth unto it in the same manner as wee shewed (when we spoke of the motion of restitution) it doth to stiffe bodies, that by violence are compressed and drawne into a lesse capacious figure, then their nature affecteth, and returne into their owne state, as soon as the murthering violence leaveth them at liberty.

Pleasure therefore, must be contrary to this, and consist in a moderate dilatation; for an immoderate one, would cause a compression in some adherent parts; and there would become paine. And conformable to this, we experience, that generally they are hard things which breed paine unto us; and that these which breed pleasure, are oily and soft, as meates, and odours, which are sweet to the taste and smell; and soft substances, which are gratefull to the touch: the excessse of all which proveth offensive and painfull; so that from the extremity of pleasure, one entrencheth presently upon the confines of paine.

Now then let us consider, how the little similitudes of bodies, which from without doe come into the fantasy, must of necessity worke there, according to their little power, effects
pro-

proportionable to what they wrought first in the outward senses, from whence, they were conveyed to the braine: for the senses (that is the nerves) and the *Septimum Lucidum*, having both of them their origine from the very substance of the braine, and differing only in degrees of purity and refinement, the same object must needs worke like effects in both, compressing or dilating them proportionably to one another: which compression or dilatation, is not paine or pleasure, as it is in the outward sense; but as it is reported to the heart: and that, being the seat of all paines or pleasures wrought in other parts, and that (as it were) dyeth them into those qualities, is not capable of feeling either it selfe: so that the strokes of any little similitudes upon the fantasy, do make only compressions or dilatations there, not paines or pleasures.

Now their bodies or similitudes, if they be reverberated from the fantasy or *Septimum Lucidum*, upon the little roots of the nerves of the sixth couple, which go to the heart, they must needs worke there a proportionable impression to what they wrought upon the fantasy, either compressing or dilating it; and the heart being extremely passive, by reason of its exceeding tendernesse and heat; cannot choose but change its motion, at the least in part, if not in whole: and this with relation to two causes: the one disposition of the heart it selfe; the other, the vehemency of the stroke.

This change of motion and different beating of the heart, is that which properly is called passion: and is ever accompaigned with pleasure or with grief, according to the nature of the impression, that either contracteth or dilateth the heart and the spirits about it: and is discovered by the beating of the arteries and of the pulse. Conformable whereunto, Physitians do tell us, that every passion hath a distinct pulse.

These pulses are divided in common, by abundance, or by want of spirits: yet in both kinds, they may have common differences; for in abundance, the pulse may be quick or slow, regular or irregular, equall or unequall: and the like may happen in defect of spirits; accordingly to the motions of the heart, which are their causes. Againe, the object by being present or further off, maketh the stroke greater or lesse: and accordingly, varieth the motion of the heart.

Let us then call to mind, how wee have formerly declared,

9.
Of Passion:

6.
Of severall
pulses caused
by passions.

that life consisteth in heat and humidity; and that these two joy-
ned together, doe make a thing great: and wee may conclude
that of necessity the motion which is most lively, must have a
great, full, and large stroake; like the even rolling waves of a
wide and smooth sea; and not too quick or smart, like the brea-
ches of a narrow *Fretum*, agitated by tempestuous windes. From
this, other motions may vary either by excesse, or by deficiency:
the first maketh the stroake become smart, violent and thicke:
the other slackeneth it, and maketh it grow little, slow, weake,
and thinne, or seldome.

And if we looke into the motions of our heart, wee shall see
these three differencies of them, follow three severall chiefe pas-
sions. The first, followeth the passion of joy: the second, the pas-
sion of anger: and the third, the passion of griefe. Nor neede we
looke any further into the causes of the severall motions; for
we see that joy and griefe; following the stroake of sense, the
one of them must consist in an oyly dilatation: that is, the spirits
about the heart, must be dilated by a gentle, large, great, and
sweet motion, in a moderation between velocity and slownesse:
the other contrariwise, following the stroak of sense in paine, as
the first did in pleasure, must contract the spirits; and conse-
quently make their motion or stroak become litle, and deficient
from all the properties we have above set down.

As for anger, the motion following that passion, is, when the
abundance of spirits in the heart is a little checked by the con-
trary stroak of sense, but presently overcome that opposi-
tion: and then, as we see a hindered water, or a man, that sud-
dainly or forcibly break through what withstood their motion,
go on with a greater violence then they did, and as it were pre-
cipitately: so the heart, having overcome the contraction,
which the sense made in it, dilateth it selfe with a fury, and
maketh its motion smart and vehement. Whence also it follow-
eth, that the spirits grow hotter then they were: and accord-
ingly, it is often seen, that in the scoulding of a woman, and in the
irritation of a dog, if ever now & then, one thwart them, and in-
terpose a little opposition, their fury will be so sharpened and
heightened, that the woman will be transported beyond all li-
mits of reason, and the dog will be made mad with nothing
else done to him, but angring him at convenient times: and
some

some men likewise, have by sleight oppositions, iterated speedily upon them, before their spirits could relent their vehement motion (and therefore, must still increase it) been angered into feavers.

This passion of anger, seemeth almost to be solitary on the side of excessse beyond joy: which is, as it were the standard and perfection of all passions; as light or whiteneffe, is of all colours: but on the other side, of deficiency, there are severall middle passions, which participate more or lesse of joy and grief: as particularly those two famous ones, which governe mans life, *Hope* and *Fear*. Concerning which, Physicians tell us, that the pulse or beating of feare, is quick, hard, and unequall: unto which I conceive we may safely adde, that it must also be small and feeble; the perfection of joy, decreasing in it on one side, to wit, from greatnesse and largenesse; but not intirely; so that a kind of quicknesse supplyeth in part the other defect. Hope on the other side, is in such sort defective from joy, that nevertheless it hath a kind of constancy, and moderate quantitie, and regularity in its motion: and therefore is accounted to be the least hurtfull of all the passions, and that which most prolongeth mans life. And thus you see how those motions, which wee call passions, are engendered in the heart, and what they are.

Let us then in the next place consider, what will follow in the rest of the body, out of these varieties of passions, once rayed in the heart, and sent into the braine. It is evident, that according to the nature and quality of these motions, the heart must needs, in every one of them, voyde out of it self into the arteries, a greater or lesser quantity of blood, and that in divers fashions: and the arteries which lie fittest to receive these sudden egestions of blood are those which goe into the braine: whose course being directly upwards, we cannot doubt, but that it is the hottest and subtillest part of the blood, and the fullest of spirits, that flyeth that way. These spirits then running a long and perplexed journey up and down in the braine, by various meanders and anfractuosities, are there mingled with the humide steame of the braine it selfe, and are therewith cooled; and doe come at the last, to smooke at liberty in the hollow ventricles of the braine, by reeking out of the little arteriall branches, that doe weave the *plexus choroides*; or net we spoke of erewhile: and

7.
Of severall other effects caused naturally in the body by passions.

they being now growne heavy, doe fall (by their naturall course) into that part or proceffe of the braine, which is called *medulla Spinalis*, or the marrow of the back bone : which being all beset by the nerves that run through the body, it cannot happen otherwise, but that these thickened and descending spirits, must either fall themselves into those nerves, or else presse into them other spirits which are before them, that without such new force to drive them violently forwards, would have slided downe more leisurely. Now, this motion being downwards, and meeting with no obstacle till it arrive unto its utmost periode that way, the lowest nerves are these, which naturally doe feele the communication of these spirits first.

But it is true, if the flowing tide of them be great and plentifull, all the other nerves will also be so suddenly filled, upon the filling of the lowermost, that the succession of their swellings, will hardly be perceptible : as a sudden and violent inundation of water, seemeth to rise on the sides of the channell, as it doth at the mill-damme; though reason assureth us it must beginne there, because there it is first stopped.

On the contrary side, if the spirits be few, they may be in such a proportion, as to fill only the lower nerves, and to communicate little of themselves to any of the others. And this is the case in the passion of fear : which being stored with fewer spirits, then any other passion that causeth a motion in the body, it moveth the legges most; and so carrieth the animal that is affrayd, with violence from the object that affrighteth him. Although in truth, it is a faint hope of escaping, mingled with fear, which begetteth this motion : for when fear is single, and at its height, it stoppeth all motion by contracting the spirits, and thence is called *stupor*; as well as grief, for the same reason: and accordingly we see extreame cowardes in the extremity of their fear, have not the courage to runne away, no more then to defend or help themselves by any other motions.

But if there be more abundance of spirits; then the upper parts are also moved, as well as the legges; whose motion contributeth to defense: but the brain it self, and the senses which are in the head, being the first in the course of this flood of spirits, that is sent from the heart to the head; it is impossible but that some part of them, should be pressed into the nerves of those senses;

senses; and so will make the animal vigilant and attentive to the cause of its feare or grieffe.

But if the feare be so great, that it contracteth all the spirits, and quite hindereth their motion (as in the case wee touched above) then it leaveth also the nerves of the senses destitute of spirits; and so by too strong apprehension of a danger, the animal neither seeth nor apprehendeth it: but as easily precipitath it self into it, as it happeneth to avoyde it; being meerly governed by chance; and may peradventure seeme valiant, through extremity of feare.

And thus you see in common, how all the naturall operations of the body, doe follow by naturall consequence out of the passions of the minde: without needing to attribute discourse or reason, either to men or beastes to performe them. Although at the first sight, some of them may appeare unto those that look not into their principles and true causes, to flow from a source of intelligence: whereas it is evident by what we have layed open, they all proceed from the due ranging and ordering of quantitative parts, so or so proportioned by rarity and density. And there is no doubt, but who would follow this search deeply, might certainly retrive the reasons of all those externall motions which we see use to accompany the severall passions in men and Beastes. But for our intent, we have said enough, to shew by what kind of order and course of nature, they may be effected (without confining our selves over scrupulously to every circumstance that we have touched) and to give a hint, whereby others that will make this inquiry their taske, may compile an intire, and well grounded and intelligible doctrine of this matter.

Only we will adde one advertisement more; which is, that these externall motions caused by passion, are of two kinds: for some of them are as it were the beginnings of the actions, which nature intendeth to have follow out of the passions that cause them: but others are not onely bare signes of passion that produce them, and are made by the connexion of parts unnecessary for the maine action that is to follow out of the passion, with other parts that by the passion are necessarily moved: as for example, when an hungry mans mouth watereth at the sight of good meate, it is a kinde of beginning of eating, or of preparation

ration for eating : for when we eat, nature draweth a moyſture into our mouth, to humectate our meate, and to convey the taſt of it into the nerves of the tongue, which are to make report of it unto the braine : but when we laugh, the motion of our face aymeth at no further end, and followeth only by the connexion of thoſe muſcles, which draw the face in ſuch a fort, unto ſome inward parts, that are moved by the paſſion, out of which laughing proceedeth.

8.
Of the Dia-
phragma:

But we muſt not leave this ſubject without ſome mention of the diaphragma : into which the other branch of thoſe nerves, that are called of the ſixt conjugation, doth come : for the firſt branch we have ſaid goeth into the heart, and carrieth thither the objects that come into the braine : and this, we ſhall find, carrieth back to the braine the paſſion or motion, which by the object is rayſed in the heart. Concerning this part of our body, you are to note, that it is a muſculous membrane, which in the middle of it hath a ſinewy circle ; whereunto is faſtened the caſe of the heart, called the pericardium. This Diaphragma is very ſenſible, receiving its vertue of feeling from the above mentioned branch of the ſixt couple of nerves : and being of a trembling nature, is by our reſpiration kept in continuall motion : and flappeth upon all occaſions, as a drum head would do, if it were ſlack and moyſt ; or as a ſayle would do, that were brought into the wind.

Out of this deſcription of it, it is obvious to conceive, that all the changes of motion in the heart, muſt needs be expreſſed in the Diaphragma. For the heart beating upon the pericardium, and the Pericardium being joyned to the Diaphragma ; ſuch jogges and vibrations muſt needs be imprinted and echoed there, as are formed in the heart : which from thence, cannot chooſe but be carried to the braine by the ſixt couple of nerves. And thus it commeth about, that we feele and have ſenſation of all the paſſions, that are moved in our heart. Which peradventure is the reaſon, why the Greekes do call this part *σπῆνς* ; and from it derive the verbe *σπῆνσθαι*, that in Latine ſignifyeth *Sapere*, with us, to ſavour or to like : for by this part of our body, we have a liking of any object, or a motion of inclination towards it : from whence *σπουδῆς* is derived, by compoſition of *σπῆνσθαι*, with *οὐδῆ* : for a prudent man is he, that liketh, and is moved

moved to compasse wholefome and good things. Which Etymology of the word, seemeth unto me more naturall, then from the phrenesy, from whence some derive it; because a great distemper or inflammation in the Diaphragma, often causeth that disease.

Now, because the object is conveyed from the braine to the heart some part of its way, by the same passage, as the motion of the heart is reconveyed back to the braine, it must of necessity follow, that who is more attentive to outward sense, doth lesse consider or reflect upon his passion; and who is more attentive to observe, and be governed by what passeth in his heart, is lesse wrought upon by externall things. For if his fantasy draweth strongly unto it, the emanations from outward agents upon the senses, the streame of those emanations will descend so strongly from the overfilled fantasy into the heart, that it will hinder the ascent of any fewer and weaker spirits by the same pipe. But if the current do set strongest upwards, from the heart by the Diaphragma to the braine, then it will so fill the pipe by which it ascendeth, that little of a weaker tyde can make a contrary eddy water in the same channell.

And by this meanes, nature effecteth a second pleasure or paine in a living creature, which moveth it (oftentimes very powerfully) in absence of the primary object: as we may observe, when thinking of any pleasing or displeasing action, we find about our heart a motion which enticeth us to it or averteth us from it: for as the first pleasure was occasioned by the stroake, which the object applyed to the outward sense, made upon the fantasy, (which can judge of nothing without being stricken by it) so the second pleasure springeth from the spirits moved in the heart, by messengers from the braine, which by the Diaphragma do rebound a stroake back againe upon the fantasy. And from hence it proceedeth, that memory delighteth or afflicteth us; and that we think of past things with sweetnesse or with remorse: and thereby assuefaction is wrought in beasts, as farre as the appetitive part doth contribute thereunto, to perfect what was begun in their cognoscitive part, by the ingression of corporeal specieses into their fantasy, in order to the same effect, as we have touched before.

But now let us examine, how so small a quantity of a body, as cometh from an object into our sense, can be the cause of so great

9.

Concerning
paine and pleasure
caused by
the memory of
things past.

10.

How so small
bodies as atoms
are, can
cause so great
motions in the
heart.

a motion about our heart. To which purpose we are to remember, that this motion is performed in the most subtile and thin substance, that can be imagined: they are the vitall spirits, that do all this work; which are so subtile, so agile, and so hot, that they may in some sort be termed fire. Now if we reflect how violent fire is, we need not wonder at the suddaine and great motion of these passions.

But we must further take notice, that they are not in the greatest excessse, but where the living creature hath been long inured and exercised unto them, either directly or indirectly: so that they arrive not to that pitch so much out of the power of the agent, as out of the preparation and disposition of the patient; as when cold water hath been often heated by extinguishing red hot irons in it, after some repetitions a few quenchings will reduce it from cold to boyling, that at the first would scarce have made it lukewarme: and accordingly we see a heart, that for a long time hath loved, and vehemently hath desired enjoying, is transported in a high degree, at the least sight and remembrance of stroaks from its beloved object; and is as much dejected, upon any the least deprivation of it: for to such an object, the living creature is hurried away by a force much resembling the gravity or celerity of a dense body, that is set on running down a steepe hill; unto which, the onely taking away of a weake let or the least stop, giveth a precipitate course, not out of the force of what is done to it, but out of the force which was formerly in the thing, though for the present it lay there undiscovered: and so likewise in these cases, the object rather giveth the occasion of the violent motion, then the force or power to it.

These things being thus determined, some peradventure may aske, how it cometh to passe, that the spirits which cause motion, being sent on their arrant by the braine, do alwayes hit the right way, and light duly into those very sinewes, which move the living creature according as is requisite for its nature? Since all the passages are open, what is it that governeth them, so as they never mistake, and the animall is never driven towards harme in steed of flying from it? Who is their guide in these obscure paths? But it were to impute ignorance to the maker, to think that he framed all the passages alike, and so every one of them

them, promiscuously apt to receive into them, all sorts of spirits, howsoever they be moved: and therefore, we may assure our selves that since in these diversities of occasions, there are likewise divers kinds of motions from the heart; either there is proportionable unto them, divers kinds of passages fit to receive and entertain the spirits, according to the condition they are in, so as the passages which are ajusted to one kind of spirits, will not admit any of an other nature: or else, the first motions of liking or disliking in the heart, which (as we have said) do cause a swelling or a contraction of it against this or that part; doth stop and hinder the entrance of the spirits into some sinews, and doth open others, and driveth the spirits into them: so as in the end, by a result of a chaine of swellings and contractions of severall parts successively one against an other, the due motions of prosecution or aversion are brought about:

As for example; an object that affecteth the heart with liking, by dilating the spirits about the heart, sendeth some into the optik nerves, and maketh the living creature turne his eye towards it and keepe it steady upon what he desireth: as contrariwise, if he dislike and feare it, he naturally turneth his eye and head from it. Now, of this motion of the eye and head, may depend the running to the thing in one case, and the running from it in the other: for the turning of the neck one way, may open a passage for the spirits into those sinewes, which carry the rest of the body towards the object: and the turning of it to the other side, may open other sinewes, which shall work a contrary effect, and carry the animall from the object: and the moving of those sinewes, which at the first do turne the neck, doth proceed from the quality and number of the spirits that ascend from the heart, and from the region of the heart from whence they are sent: according to the variety whereof, there are divers sinewes fitted to receive them.

To make up which discourse, we may call to mind, what we have said a little above, concerning the motions caused in the external parts of the body, by passion moving within: as when feare mingled with hope, giveth a motion to the legs, anger to the armes & hands, and all the rest of the body, as well as to the legs; and all of them, an attention in the cutward senses; which neverthelesse perverteth everyone of their functions, if the passion be in extremity

And

And then surely, we may satisfie our selves, that either this, or some way like it (which I leave unto the curious in Anatomy to settle with exactnesse; for it is enough for my intent, to shew in grosse how these operations may be done, without calling in some incomprehensible qualities to our ayd) is the course of nature in motions; where no other cause interveneth, besides the object working upon the sense: which all the while it doth, it is the office of the eye of fantasie or of common sense, to lie ever open; still watching to observe what warnings the outward senses doe send unto him; that accordingly he may direct and change the motions of the heart and of the whole body.

12

How men are
blinded by pas-
sion.

But if the object do make violent impressions upon the sense; and the heart, being then vehemently moved, doe thereupon send abundance of spirits up to the braine; this multitude of spirits thronging upon the common sense, oppresseth it (as we have already said) in such sort, that the notice which the sense giveth of particular circumstances, cannot prevaile to any effect in the braine: and thus by the misguidance of the heart, the worke of nature is disordered: which when it happeneth, we expresse in short, by saying that passion blindeth the creature; in whom such violent and disorderly motions have course; for passion is nothing else, but a motion of the blood and spirits about the heart; and is the preparation or beginning of the animals working; as we have above particularly displayed.

And thus you see in common, how the circuit is made from the object to the sense; and from it by the common sense and fantasie, to the heart; and from the heart backe againe to the braine; which then setteth on worke those organes or parts the animal is to make use of in that occasion: and they either bring him to, or carry him from the object, that at the first caused all this motion, and in the end becommeth the period of it.

THE SIX AND THIRTIETH CHAPTER,

Of some actions of beasts, that seem to be formall acts of reason, as doubting, resolving, inventing.

IN the last Chapter the foundations are layd, and the way is opened, for the discovering how all operations which proceed from nature and passion, are performed among living creatures: and therefore, I conceive, I have thereby sufficiently complied with the obligation of my intention: which is but to expresse and shew in common, how all the actions of sensible bodies may be reduced to locall motion, and to materiall application of one body unto another, in a like manner (though in a different degree) as those motions which we see in liveliest bodies. Yet because among such animals as passe for irrationall, there happen some operations of so admirable a straine, as resemble very much the highest effects which proceed from a man: I thinke it not amisse, to give some further light, by extending my discourse to some more particulars then hitherto I have done; whereby the course and way how they are performed, may be more clearely and easily looked into: and the rather, because I have met with some men, who either wanting patience to bestow on thoughts of this kind so much time as is necessary for the due scanning of them; or else through a promptitude of nature, passing swiftly from the effect they looke upon in grosse, to the most obvious seeming cause; do suddenly and strongly resolve, that beasts use discourse upon occasions, and are endewed with reason.

This I intend not to doe quite in particular, for that were to write the history of every particular animal: but will content my selfe with touching the causes in common; yet in such sort, that the indifferent Reader may be satisfied of a possibility, that these effects may proceed from materiall causes: and that I have pointed out the way, to those who are more curious; and have the patience and leisure to observe diligently what passeth among beasts, how they may trace these effects from step to step, untill at length they discover their true causes.

¹
The order and connexion of the subsequent Chapters.

To begin then ; I conceive we may reduce all those actions of beasts, which seeme admirable, and above the reach of an irrational animal, unto three or foure severall heads. The first may be of such, as seeme to be the very practice of reason, as doubting, resolving, inventing, and the like. The next shall be of such, as by docility or practise beasts doe oftentimes arrive unto. In the third place, we will consider certaine continueate actions of a long tract of time, so orderly performed by them, as that discourse and rational knowledge seem clearly to shine through them. And lastly, we will cast our eye upon some others, which seeme to be even above the reason that is in man himselfe as the knowing of things which the sense never had impression of before, a prescience of future events, providences, and the like.

2
From whence
proceedeth the
doubting of
beasts.

As for the first : the doubting of beasts, and their long wavering sometimes between objects that draw them severall waies; and at the last their resolving upon some one of them, and their steady pursuance of that afterwards; will not be matter of hard digestion to him, that shall have well relished and meditated upon the contents of the last Chapter: for it is evident, that if severall objects of different natures do at the same time present themselves unto a living creature, they must of necessity make divers impressions in the heart of it, proportionable unto the causes from whence they proceed: so that if one of them be a motion of hope, and the other be of feare; it cannot choose but follow thence, that what one of them beginneth, the other will presently breake off: by which meanes it will come to passe, that in the beasts heart there must needs be such waverings, as we may observe in the sea, when at the beginning of a tide of flood, it meeteth with a banke that checketh the comming in of the waves, and for a while, beateth them backe as fast as they presse upon it; they offer at getting over it, and by and by retire back againe from the steepnesse of it, as though they were apprehensive of some danger on the other side; and then againe attempt it a fresh: and thus continue labouring, one while one way, another while another; untill at the length the flood increasing, the water seemeth to grow bolder, and breaketh amaine over the banke, and then floweth on, till it meeteth with another, that resisteth it, as the first did: and thus you see, how the sea can doubt

doubt and resolve, without any discoursing. In the like manner it fareth with the heart of a beast (whose motions do steere the rest of the body) when it beateth betwixt hope and feare, or between any other two contrary passions, without requiring any other principles from whence to deduce it, then those we have already explicated.

But now to speake of their invention; I must confesse, that among severall of them, there appeareth so much cunning in laying of their plots (which when they have compassed, they seem to grow carelesse, and to unbend their intention, as having obtained what with earnestnesse they desired) that one might think they wrought by designe, and had a distinct view of an end, for the effecting of which, they used discourse to choose the likeliest meanes.

To this purpose the subtilties of the fox are of most note. They say he useth to lie as if he were dead; thereby to make hennes and duckes come boldly to him. That in the night when his body is unseene, he will fix his eyes upon poultry, and so make them come downe to him from their roost. That to rid himselfe of the fleas that afflict him in the summer, he will sinke his body by little and little into the water, while the fleas creep up to his head (to save themselves from drowning) and from thence to a bough he holdeth in his mouth; and will then swimme away, leaving them there. That to cōsen the badger of his earth, he will pisse in it; as knowing that the ranke smell of his urine, will drive the other cleaner beast to quit it. That when dogges are close upon him, and catching at him, he will pisse upon his taile, and by firking that up and downe, will endeavour (you may beleeve) to make their eyes smart, and so retard their pursuit, that he may escape from them.

And there are particular stories, that expresse yet more cunning then all these: as of a fox, that being sore hunted, hanged himselfe by the teeth among dead vermine in a warren; untill the dogges were passed by him, and had lost him. Of another, that in like distresse, would take into his mouth a broome bush growing upon a steepe cliffe on the side hand neere his denne (which had another way to it, easie enough of access) and by helpe of that, would secure cast himselfe into

3.
Concerning
the invention
of Foxes and
other beasts,

his hole; whiles the dogges that followed him hastily, and were ignorant of the danger, would breake their necks downe the rockes.

It is said, that in Thracia, the Countrey-people so know whether the rivers that are frozen in the winter, will beare them or no, by marking whether the foxes venture boldly over them, or retire after they have layed their eares to the yce, to listen whether or no they can heare the noyse of the water running under it: from whence you may imagine they collect, that if they heare the current of the streame, the yce must needs be thinne; and consequently dangerous to trust their weight unto it.

And to busie my selfe no longer with their subtilties, I will conclude with a famous tale of one of these crafty animals; that having killed a goose on the other side of the river, and being desirous to swim over with it, to carry it to his denne, before he would attempt it (lest his prey might prove too heavy for him to swim withall, and so he might lose it) he first weighed the goose with a piece of wood, and then tryed to carry that over the river, whiles he left his goose behind in a safe place; which when he perceived he was able to do with ease, he then came backe againe, and ventured over with his heavy bird.

They say it is the nature of the Iacatray to hide it selfe, and imitate the voyce of such beasts, as it useth to prey upon; which maketh them come to him as to one of their own fellows; and then he seifeth upon them and devoueth them.

The Iaccall, that hath a subtille sent, hunteth after beasts; and in the chase, by his barking guideth the Lyon, (whose nose is not so good) till they overtake what they hunt; which peradventure would be too strong for the Iaccall; but the Lyon killeth the quarry, and having first fed himselfe, leaveth the Iaccall his share: and so betweenthem both, by the ones dexterity, and by the others strength, they get meate for nourishment of them both.

Like stories are recorded of some fishes. And every day we see the invention of beasts to save themselves from catching: as hares, when they are hunted, seeke alwaies to confound the sent; sometimes by taking hedges, otherwhiles waters; sometimes running among sneepe and other beasts of stronger sent;

Some-

sometimes making doubles; and treading the same path over and over; and sometimes leaping with great jumpes hither and thither, before they betake themselves to their rest; that so the continuatenesse of the sent may not lead dogges to their forme.

Now to penetrate into the causes of these and of such like actions; we may remember, how we shewed in the last Chapter, that the beating of the heart worketh two things: the one is, that it turneth about the specieses, or little corporeities (tremming from outward objects) which remaine in the memory: the other is, that it is alwaies pressing on to some motion or other: out of which it hapneth, that when the ordinary waies of getting victuals, or of escaping from enemies. doe faile a creature whose constitution is active; it lighteth sometimes (though peradventure very seldome) upon doing something, out of which the desired effect followeth; as it cannot choose but fall out now and then, although chance onely doe governe their actions: and when their action proveth succesfull, it leaveth such an impression in the memory, that whensoever the like occasion occurreth, that animal will follow the same method; for the same specieses doe come together from the memory into the fantasie. But the many attempts that miscarry, and the ineffectuall motions which straights doe cast beasts upon, are never observed, nor are there any stories recorded of them: no more then in the Temple of Neptune, were kept upon the registers, the relations of those unfortunate wretches, who making vov'es unto that God in their distresse, were neverthelesse drowned.

Thus peradventure, when the fox seeth his labour in chacing the hens, to be to no purpose; and that by his pursute of them, he driveth them further out of his reach; he layeth himselfe downe to rest, with a watchfull eye, and perceiving those silly animals to grow bolder and bolder, by their not seeing him stir, he continueth his lying still, untill some one of them commeth within his reach, and then on a sudden, he springeth up and catcheth her: or peradventure some poultry might have strayed within his reach whiles he was asleepe, and have then wakened him with some noise they made: and so he hapnied to seise upon one of them, without either designe or paines taking before-

hand:

40
Of foxes that
catch hens by
lying under
their roost, and
by gazing upon
th.m.

hand: by such degrees he might chance to catch one the first time: and they being settled in his memory, together with the effect; it happened that another time when hunger pressed him, and sent up to his braine like spirits unto those which ascended thither while he lay watching the hens; these spirits brought the other from his memory into the fantasie (in such sort as we have shewed in the last Chapter) and so drove him to the same course, untill by frequent repetitions, it became ordinary and familiar with him: and then they that looke onely upon the performance of the artifice, are apt to infer discourse and a designe of reason, out of the orderly conduct of it.

But how can we conceive the fox hath judgement to know when the henne is come within his leape, and accordingly offereth not at her till then; unlesse we resort to some other principles, then what is yet declared? The answer unto this objection I thinke will not be hard to finde; for if the motion, which the presence of the object maketh in the heart, be proportioned out by nature (as there is no doubt but it is) it will not be so great and powerfull, as to make the fox leape at it, untill it be arriued so neere him, that by his nimbleness he can reach it; and so without any ayme, further then by the meere fluxe of his passion conveniently raised, he doth the feate: but if his passion be too violent, it maketh him misse his ayme; as we may frequently observe both in men and beasts: and particularly, when feare presseth either of them to leape over a ditch, which being too broad, he lighteth in the midst of it.

The same watchfulness and desire to have the poulen, that sit upon a tree out of his reach, maketh him fix his eyes upon them, when they are at rooste: and at length, either the brightness and sparkling of them, dazeleth the birds, and maketh them come downe to them, (as flies do in the night about the flame of a candle; or as fishes doe to a light in a boates head;) or else they are affraid; and their feare increasing, their spirits returne to the heart, which thereby is oppressed, and their outward parts are bereaved of strength and motion; from whence it followeth necessarily, that their footing looseth their hold fast; and they tumble downe halfe dead with feare, which happeneth also frequently to catts when they looke wistly upon little birds that sit quietly. Or peradventure, their feare maketh them giddy;

as when some man looking downe a precipice from a dangerous standing, he falleth by the turning of his braine, though nothing be behind him to thrust him forwards. Or it may be, some steame commeth from the Fox, which draweth such creatures to him; as it is reported that a great and very poisonous Toade will do a Weasell, who will run about the Toade a great while, and still make his circle lesser and lesser, till at length he perisheth in the center, where his foe sitteth still, and draweth him to him: which he doth in such sort, as animated Mercury will draw leafe-gold duly prepared, or as the loadstone attracteth Iron: and yet it is apparent, the Weasell commeth not with his good will; but that there are some powerfull chaines, steaming from the body of the Toad, which plack him hither against his liking; for by his motions and running, he will expresse the greatest feare that can be.

The method which Foxes do practise, to ridde themselves of their fleas (if it be true) is obvious enough for them to fall upon; for in summer, their fleas together with their thick furred coate, cannot choose but cause an exceeding great itching and heate in their bodies; which will readily invite them to goe into the water to coole themselves; as the Merchants at the Isles of Zante and of Cephalonia told me (when I was there) it was the custome of our English Doggs (who were habituated unto a colder clime) to runne into the Sea in the heate of Summer, and lie there most part of the day, with onely their noses out of the water, that they might draw breath, and would sleep there with their heads layed upon some stone, which rayfed them up, whiles their bodies were covered with the Sea: and those Dogs which did not thus, would in one summer usually be killed with heate and Fleas.

Now when the Fox feeleth the ease that the cooleneffe of the water affordeth that part of him which sitteth in it, he goeth further and further; yet would not put himselfe to swim, which is a labour, and would heate him, and therefore he avoideth it; so that whiles he thus cooleth himselfe in some shady place (for it is naturall unto him, in such an occasion, to resort unto the coole shade, rather then to lie in the Sunne) and in such there being for the most part some boughes hanging over the water, it happeneth naturally enough, that he taketh

5.

From whence proceedeth the Foxes invention to ridde himselfe of Fleas.

some of the lowest in his mouth, to support him, and save him the labour of swimming, whiles he lyeth at his ease, soaking and cooling himselfe in the River. By which meanes it commeth to passe, that the Fleas finding no part of him free from water, do creepe up to the bough to rescue themselves from drowning: and so, when he is cooled enough, he goeth away and leaveth them there. In all which finding a benefit and satisfaction, whensoever the like occasion bringeth those species, from his memory into his fantasy, he betaketh himselfe to the same course, and therein finding his remedy, at length it groweth familiar to him.

In the like manner, Thales his Mule, that was heavily loaden with Salt, happening to stumble, and to fall in a River she was going over, the Salt melted by the water soaking into the sacks, and so she was eased of her burden; which successe made her, whensoever she came to a river, and was troubled with her loading, shee would lie downe in the water; and could not be reclaymed from it, till they charged sacks of wooll upon her backe, which growing heavier by their imbibing of water, weaned her from her former crafty habit. By which it is apparent, that it was memory and not judgement, which made her for a while believe her selfe so subtilly.

For the Foxes driving the Badger from his earth, you will not thinke it needfull to allow him a forecast and designe in pissing in it: but as it is naturall for him, to rest in a place that he meeteth with fit for that purpose; so it is for him to pisse in it, if the list take him whiles he is there; which in all likelyhood it will, if he stay any time there, and give a relaxation to all his parts by sleep.

And when he pisseth in his taile, and shaketh it in the Dogs eyes, it is evident that feare, not craft causeth this effect; for it avayleth him little, and therefore is not likely to proceed from judgement. And of the other, it is a naturall effect in all beasts (when it is violent) to contract their tailes betweene their legs, and to make their urine come from them, (by compressing the spirits in their heart, which should support their outward parts, and strengthen their splineter muscle) which their being snapped at and seised upon by the Dogs, shaketh from their bushy tailes (fit to retaine it) and then lighting in the Dogs eyes,

6.
An explication of two other inventions of Foxes.

the

the acrimony of it hurteth them, and maketh them shut their liddes.

The story (if it be true) of the Fox, that to save himselfe from the Dogs that he heard following him in full cry, did hang by his teeth among dead vermine in a warren, is a very strange one I confesse : but it is conceivable, how feare and wearinesse might cause him to seeke a shelter to hide himselfe : and in so plaine a tract of ground as warrens use to be in, without any bush or hill to have recourse unto for reliefe, there appearing nothing but a gallowes hanging full of vermine ; his fantasy might be moved (he being able to run no further) to thrust himselfe among those dead bodies, that he saw reitied quietly : and having no way to mingle himselfe with them, but hanging by his teeth ; he might continue in that posture, till the Dogs not suspecting him in the ayre, might run under him, and overshoot the sent : which whiles they cast about to recover, by running to beate the next wood or shelter in view (as is their custome in losses of their chance ; unto which they are brought by their masters hunting them in that method at the first) the wily animall stealeth an other way, and recovereth himself.

This overrunning of the sent by Dogs in the earnestnesse of their chace, putteth me in mind of Montagues argument, out of which he will infer, that Dogs use discourse, and do make syllogisines in their hunting : for (saith he) when they have followed their chace downe a Lane, that at length divideth it selfe into three others ; they will carefully smell at the first and at the second, and not finding that it hath gone in either of those, they boldly runne upon the third, without ever laying their Noses to the ground ; as being assured by their discourse and reason, that since it went not in the two first, and there being but one remaining, it must of necessity have gone there.

But this needeth no other cause, then that their eagernesse of hunting having made them overshoot the sent, (which for a while remaineth in their noses, after they are parted from the object that caused it) they cast back againe (as they are accustomed to be made to do in like occasions by the hunters that train them up) and with their noses they try the ground all the way they goe ; till comming neere where the chace went indeed, the

7.
Concerning
Montagues
argument to
prove that
Dogs make
syllogisines.

sent striketh their Noses (that by this time are growne empty of it) before they come at the place : and then they run amaine in pursuit of it, with their heads held up, (which is their convenientest posture for running) and all the way, the sent filleth them at that distance without their needing to smell upon the Earth, to fetch it from thence.

8.
A dec'ration
how some
ricks are per-
formed by
foxes, which
seme to argue
ifcourse.

That Fox which used to cast himselfe by the advantage of a bough into his Denne, was so closely pursued by the Dogs the first time hee ventured upon this feate, that he had not time to goe into his Earth (his ordinary retreat, when hee is neerer it) by the easy and accessible way ; but on the one side, to get thither being strong in his fantasy, and on the other side, the precipice which he had often seene, coming likewise thither from his memory ; these two concurring could not choose but make him goe warily thither : and in so dangerous a leape, it is naturall for him, to helpe himselfe by any thing in the way that can advantage him : which happening to bee by catching in his mouth a bough that hung over his Den, (the onely suddaine meanes hee had to take hold of any thing) and from thence taking as it were a new rise for a second leape, he findeth himselfe in security : whiles the Dogs unacquainted with the place, runne violently on, as in the rest of their chace : and so are upon the brim of the precipice, before they perceive it ; and then it is too late for them to stop their course, and consequently, they break their necks. Which mischief to them the Fox needeth not have in his designe, and accordingly tolle them that way ; but chance begetting this deliverance of him at the first, when he was so hard pressed, his memory teacheth him to follow the same course, whensoever the like occasion occurreth.

But how many Foxes do there perish in attempts, which if they succeeded, would have beene accounted by slight judgers, to be notable subtilities ; but miscarrying are esteemed tumultuary motions without designe, caused by that animalls fantasy and spirits, when he is in extremity ? I remember how upon a time, when I was hunting one, hee being hard set, and but a little before the Dogs and the Hunters caught in his mouth the bough of a crooked Ash-tree he runne up a pretty way ; which being in a hedge, he thereby hung down along the side of
the

the hedge, and when we struck him over the ribs with our poles, he would not quit his hold, (so strongly the feare of the dogs wrought in his fantasy) till greater blowes knocked him on the head. Which sheweth evidently that this action, was the effect of chance pressing his fantasy to do something ; and not any reason or discourse providing for his safety : as we have already said upon occasion of the others hanging among the dead vermine in the warren.

Those in Thracia, that will not goe over a frozen River, when the yce is too thin to beare them, are by their memory, not by their judgement, taught to retire ; for at other times they have been wetted, when they have heard the noise of the streame running under the yce : or the very running of the water calleth the specieses of swimming out from their memory, along with it into their fantasy (neither of which is pleasant to them in the winter) and so disliking the noise for the other effects sake, that used to accompany it, they avoyde that which begetteth it, and so retire from the river. And the reason of their listening to the noise, proceedeth from the spirits, that their passion upon apprehension of a danger presseth into the nerves of their senses, as well as into the other nerves of their braines ; which accordingly maketh them so vigilant and attentive then to outward objects and motions.

That the Jaccaray or Hyæna, when he is hungry, should have his fantasy call out from his memory, the Images of those Beasts, which use to serve him in that occasion, is the ordinary course of nature : and that together with those images, there should likewise come along the actions and sounds which used to accompany them, and are lodged together with them in the memory, is also naturall ; then, as little strange it is, that by his owne voyce he should imitate those sounds, which at that time do so powerfully possesse his imagination : and having a great docility in those Organs which forme the voice, like a Parrat he representeth them so lively, that the deceived beasts flock to him, and so are caught by him : which at the first happeneth by chance, but afterwards by memory, and groweth familiar to him.

Nor can we imagine, that the Jaccall hath a designe of serving the Lyon ; but his nature being (like a dog) to bark when

9.
Of the Jaccarays invention in calling beasts to himselfe.

II.
Of the Jaccalls designe in serving the Lion.

he feeleth the sent hot (which he pursueth for his owne sake) the Lyon that dwelleth in the same woods with him , meeteth with the noife, and followeth it; and peradventure would kill the Jaccall himselve, as well as what he hunteth, if he could overtake him : but he being too nimble for the Lyon, keepeth out of his reach ; till having wearied the beast he chaceth the Lyon that followeth by the cry, commeth in when he is at 'abay, and soone teareth in pieces what the other had not strength enough so suddainly to master, and feedeth himselve upon the Quarry till he be full. All this while the Jaccall dareth not come neere the Lyon, but standeth at a distance with feare wayting till he have done, and then after he is gone away, hee taketh his turne to feede upon what his surly master hath left.

11.
Of severall
inventions of
fishes.

The like reason it is probable we might find out among those Fishes that serve one another; if we had the conveniency of observing particularly how they behave themselves ; as when the Whale hath service from his little guide (if the report be true ; which is a necessary circumstance to be inserted in every such tale) and others of the like staine.

The fittlety of the Torpedo (who hideth himselve in the mud to benum Fishes, that may afterwards serve him to feed upon) will not require to have its origine from reason, and be done by designe ; when you shall consider it is naturall for such cold Creatures to immud themselves : and then the Fishes that swim within the reach of his benumbing faculty, will be stayd and frozen there : which because they see him not, they apprehend not, till it be too late for them to avoid it : and then, when the Torpedo commeth out, he feedeth upon what he findeth lying ready in his way.

And in like manner, the Scuttle-fish, when he is in straights of being taken by the Fisherman, casteth out a blackness that is within him, and so making the water become like Inke, he oftentimes escapeth their hands in the darkened Element : which ariseth from no discourse of his, but feare maketh him voyd this liquor that is in him (as it made the Fox voyd his Urine) and in consequence thereunto, the effect followeth.

12.
A discovery
of divers things
done by hares,
which seeme to
argue discowse.

Laitly, when Hares do use those meanes we have mentioned to confound the sent, and to save themselves from the dogs that

that hunt them, we may observe, that they take therein the readiest wayes, and the most obvious unto sense, to avoid the evill they flie from. For what can be more direct to that effect, then to hide themselves in hedge bottomes, or in woods? Or to swim over a River, when that is the most immediate way to runne from the dogges? And when they are in a plaine, where there is no other shelter but flocks of sheepe or heards of deere, what can be more naturall, then for them to hide themselves among them, and run along with them, till the cry of the approaching hounds fright them away, whiles those tamer beasts abide it neerer?

Their doublings backward and forward, may proceed from their feare, that diverteth them still from the way they are in at present, till the dogs comming neer, do put the hare out of those waverings, and do make her run straight away: for they never double but when they are a great way before the dogs, and do not heare them. Or else it may be, that not hearing or seeing the dogs, their feare may be almost passed; and then the agitation which their spirits are in, governeth the motions of their body, and will not let them rest untill they be more appeased, (as you see weary people, that at their first ceasing from running, cannot sit still: the like of which happeneth also frequently in the motions of joy or of anger) and so it maketh them walke backwards and forwards, in a pace proportionate to the agitation of the spirits within: and sometimes those moved spirits doe make them bound and leape to and fro (like the loafe with quicke silver, we have heretofore spoken of) as they issue from the heart by pulses and stroakes; which happeneth when they begin to settle towards rest. Or else peradventure their forme is so framed, that if they should get into it otherwise then by a jumpe, they would disorder some part of it, and so be unfenced and acold, or otherwise at unease during their repose: and therefore their jumping to and fro, before they leap plump in, is to take their aime; not much unlike to dogs, turning about severall times before they lie down: for hare-finders (who use to watch them) say they will do thus, though they be not pursued. And thus these actions which are imputed to craft, thereby to confound the dogs, or to wisdom, to walke themselves untill they be growne into a

fitting temper to fit still; may all of them be reduced to those materiall and corporeall causes, which make them do their other ordinary motions, wherein we find no difficulty.

13.
Of a Fox reported to have weighed a Goose, before he would venture with it over a River; and of fabulous stories in common.

If that of the Foxes weighing his Goose, before he would venture to carry it over the river, were plainly true, as it is set down; I avow I should be hard set to find the principles from whence that discretion in him proceeded: but I conceive this tale may be paired with that, which telleth us of an other Fox, who having his prey taken from him by an Eagle, brought the next day a new prize in the same place, having first rolled it in the fire, so that some burning coales stuck upon it; which the Eagle comming againe and snatching from him, carried to her Nest, which was thereby set on fire; and the young ones falling down, became the Foxes share, instead of what their damme had robbed him of. Such stories so quaintly contrived, are fitter for a morall then for a naturall Philosopher: Æsop may entertaine himselfe and his Disciples with them; whiles all the reflection I shall make upon them, is, that when I heare any such finely ordered Tales, I cannot doubt but they are well amended in the relation, by those that tell them: it being the inclination and custome of most men, (partly through a desire of having strange things come from them; and partly out of a care that what they say may appeare like truth, and so be the easier believed) to add circumstances beyond the truth of the matter: which increasing at every new mans relation of the same accident (for this humour raigneth very generally) at the length, so handsome, and yet so strange a Tale is composed, that the first author or teller of it, wondereth at it as well as others, and cannot discern that his story begot this latter.

Therefore, when one of these fine tales is proposed to speculate upon, and that I have no light to guide me in determining what part of them to allow, and what to reject; I thinke it better to expect an authenticke record of it; then be too hasty at guesse: leaving such as pretendability in reading of Riddles, to descant of the wayes how such actions may be effected: but for others, that have a semblance of truth, or do happen ordinarily, be they at the first sight never so like the operations of reason, I doubt not but that the causes of them may be reduced to the

the principles we have already established; and the waies of performing them may be pitched upon by such discourses about them, as we have made about those examples we have above produced. Especially if the actions themselves were observed by one that could judge of them, and were reported with a desire of expressing the truth nakedly as in it selfe it lieth; for divers times it hapneth, that men saying nothing but truth, do expresse it in such amanner, and with such terms, that the ignorant hearer conceiveth the thing quite another way, then indeed it is, meerly for the too emphaticall expressions: especially if the relatour himselfe misleth in conceiving the true causes of what he reporteth, and so expresseth it proportionable to those which he apprehendeth.

To conclude then this first branch, we see how the doubting, the resolving, the ayming, the inventing, and the like, which we experience in beasts, may by the vestigiaes we have traced out, be followed unto their root, as far as the division of rarity and density; without needing to repaire unto any higher principle, saving the wisdom of the orderer and Architect of nature, in so admirably disposing and mingling these material, grosse, and lifelesse bodies, that strange effects and incomprehensible unto them, who will not looke into their severall joynts, may follow out of them, for the good of the creature in whose behalfe they are so ordered:

But before we go to the next point, we cannot forbear mentioning their vanity as well as ignorance, who to purchase the estimation of deeper knowers of nature, would have it believed, that beasts have compleat languages, as men have, to discourse with one another in; which they wanted they had the intelligence of. It is true, that in us speaking or talking is an operation of reason; not because it is in reason, but because it is the worke of reason by another instrument; and is no where to be found without reason: which those irrational Philosophers, that pretended to understand the language of beast, allowed them, as well as the ability of talking to one another: but it was because they had more pride then knowledge. Of which ranke one of the chief was Apollonius, surnamed from Thyana; for if he had knowne how to looke into the nature of beasts, he would have perceived the reason of the divers voyces which the same beast in divers occasions formeth.

^{14.}
Of the severall cryings and tones of beasts: with a refutation of those authors who maintain them to have compleat languages.

This

This is evident, that an animals lungs and chest, lying so neere as they doe unto his heart; and all voyce being made by the breathes comming out of his mouth, and through his windpipe; it must necessarily follow, that by the divers ordering of these instruments, his voyce will become divers; and these instruments will be diversly ordered in him, according to the divers motions of his heart: that is, by divers passions in him (for so we may observe in our selves, that our breath is much changed by our being in passion;) and consequently, as a beast is agitated by various passions, he must needs utter variety of voyces, which cannot choose, but make divers impressions in other beasts, that have commerce with him; whether they be of the same kind, as he is, or of a different: and so we see, that if a dog setteth upon a hog, the bitten hogs cry maketh an impression in the other hogs, to come to their fellows rescue, and in other dogs to runne after the crying hog: in like manner, anger in a dog maketh snarling or barking; paine, whining; desire, another kind of barking; and his joy of seeing a person that he useth to receive good by, will breake out in another kind of whining. So in a henne, her divers passions worke divers kinds of clocking; as when she seeth a kite, she hath one voyce; when she meeteth with meate, another; when she desireth to gather her chickens under her wings, a third: and so, upon divers occasions, a divers sound; according to the divers ordering of her vocall instruments, by the passion which presseth her heart. So that who would looke curiously into the motions of the dispositions of a beasts vocall instruments, and into the motions of the spirits about his heart (which motion we have shewed is passion) would be able to give account, why every voyce of that beast was such a one, and what motion about the heart it were that caused it.

And as much may be observed in men, who in paines and griefes, and other passions, doe use to breake out into those voyces, which we call interjections, and which signifie nothing in the understanding of them that forme them, but to the hearer are signs of the passion from whence they proceed: which if a man doe heedfully marke in himselfe, he will perceive, that they are nothing else, but the sudden eruptions of a great deale of breath together, caused by some compression made within him, by the paine

paine he is in. Which is the reason that the striving against groanings in certaine occasions, doth sicke persons much harm; for it disordereth the naturall motions of some principall parts within him, that are already too much agitated; and the counter-motion by which they are checked, putteth them further into a more violent agitation. In the observation of these naturall eruptions of mens breath, caused by passion, our forefathers of old were so industrious, as to transferre the imitation of nature in this particular into Musicke, so that their kinds of Musicke were distinguished according to the division of mens passions; and by similitude would raise them in the hearers.

Out of this discourse also reason may be given, why birds are more muscical then other creatures, to wit, because they are of a hotter complexion; and therefore, to their bignesse, doe require more breath and ayre to coole them; and consequently doe make more noise, and more variety of it. Likewise, among beasts, dogs are the most vocal of any that converse with us; who by their ready anger appeare to be the hottest. Among men, those that are merry, or soone become heated with a little wine, are given to talking or singing: and so are children, and women likewise; not so much through abundance of heate, as because their heat dothe easily vent.

And thus it is evident, that there is no true language among beasts: their voices not being tokens of divers things or conceptions, but meereley the effects of divers breathings, caused by divers passions. Wherefore, since both breathing and passion, are easily reduced to the common principles of rarity and density; we need not trouble our selves any further, to seeke into the origine of this vocall faculty of beasts.

THE SEVEN AND THIRTIETH CHAPTER.

Of the docility of some irrational animals; and of certaine continuat actions of a long tract of time so orderly performed by them, that they seeme to argue knowledge in them.

1.
How hawkes and other creatures are taught to do what they are brought up to.

AS for docility, (which is our second head) Apes and Elephants are most famed. Though peradventure, the cunning and obedience of our hawkes and dogs, is no whit inferiour to what is reported of them; and would be as much admired, were it not so common. I have by sundry persons who have seen him, been told of a baboone, that would play certaine lessons upon a guittare. The Indian histories make mention of Apes, that will goe to the Tavernic and fetch Wine for their masters; as Lipsius his dog would bring his master as much meat from the market, as he carried money to his butcher to pay for. Of Elephants likewise, strange things are told: but because we cannot easily judge how to understand reports, whereof we have not seen the experience, nor how farre to believe them, I intend not to insist upon the examining of them; for by looking into the nature and art of our hounds that follow a suite of blood, or that draw dry foot; and of our hawkes, especially of the decoy ducks and cormorants; a scantling may be given at all the rest. And although these things told at random, may justly seeme very admirable to any man the first time he heareth of them; yet to him that understandeth how they are taught, there is no one passage but will appeare plaine enough.

The first degree is to tame the hawke by watching her from sleepe, and to acquaint her with the man, by continually carrying her upon his fist, and using her to take her meat quietly, as she sitteth upon his hand. Then he maketh her hop a little way to it in a paire of cranes: and after a while, kill a seeled pigeon; from which he taketh her when she is growne steady in her lesson so farre and feedeth her up with other meate: and thus in time he bringeth her to flie at what he will have her, and to be content with

with a small reward; leaving her quarry to her matter; so that a Spectatour, who understandeth not the mystery, nor ever saw hawking before, may well admire to see a bird so dutifully and exactly obey a mans command: and may conceive she hath a reasonable soule, whereby to understand him, and discourse of the meanes to bring his purpose to effect. Whereas indeed, all this is no more, then to make her doe for you and when you please, the same which she doth by nature to feed her selfe.

The cunning of dogs is begotten in the same way. Coyducks are beaten and whipped to what they are taught, like setting dogs. Cormorants have their throats tied, that they may not swallow the fish they catch, but be constrained to bring it to the man that employeth them; so that looking along step by step, you shall meet with nothing but what is plaine and easie to be taught, and to be performed by sense and memory; without needing to attribute any discourse or reasoning unto beasts.

Apes are likewise taught as dogs may be, to carry things to a certaine house; where receiving what is given them, they returne home with it: and you may be confident, this serviceablenesse of the Ape, grew out of his being carried first to the taverne by the mayd or boy, who there gave him somewhat that pleased him; and then being made to carry the pot along by the boy; and afterwards being made to carry money in one hand, and the pot in the other; whereof some drawer discharged him of the one, and filled the other, and withall gave him a reward; which also was repeated to him at his returne home with his full pot: till at the last, when he was sufficiently used to this exercise, he would of himselfe goe straight thither, as soon as he was harneſſed in such sort as he used to be for this service. Which appeareth to be assuefaction and custome, not judgement, by his receiving indifferently whatsoever is put into his pot.

And by the tale of Lipsius his dog; from whom other lesse dogs, snatching as he trotted along, part of what hung out of his basket (which he carried in his mouth) he set it downe to werry one of them; whiles in the meane time, the others fed at liberty and at ease upon the meate that lay there unguarded; til he coming backe to it, drove them away, and himselfe made an end

of eating it up. Whereby we may conceive that the species of carrying his basket to his master (which custome had settled in his memory) was disordered, and thrust out of his fantasie, by a stronger, of fighting for his meat with the other cures: after which it followed naturally in his fantasie; to eat what he had fought for. And that sending then spirits into his nerves, agreeable to the nature of it, and governing the parts depending of the braine, a motion and action ensued, which was suitable to the object in the fantasie; and this could be none other, but of eating what the fantasie found conformable unto its nature.

2.
Of the Baboone
that played on
a guitarrc.

The baboone we have mentioned, might be taught some lessons made on purpose with very few stops, and upon an instrument whereon all the strings may be stricken with one blow, and but one fret to be used at a time, and that fret to be stopped with one finger: of which much labour and time might beget a habit in him: and then, imitation of the sound, might make him play in due measure. And if we will marke it in our selves, we shall see, that although in the first learning of a lesson upon the Lute, we imploy our reason and discourse about it; yet when we have it very perfect, our fingers (guided by a slight fantasie) doe fall by custome, without any reflexion at all, to play it as well as if we thought never so carefully upon it. And there is no comparision; betweene the difficulty of a guitarrc and of a lute.

I have been told that at the Duke of Florence his marriage, there was a dance of horses, in which they kept exact time of musicke. The meanes used for bringing them to it, is said to have been by tying and hampering their legs in such a sort, that they could lift them up but in a determinate way: and then setting them upon a pavement, that was heated underneath so hot that they could not endure to stand still, while such muscicall ayres were played to them, as fitted their motions. All which being often repeated, the horses tooke a habit, that in hearing those ayres, they would lift up their legs in that fashion; and so danced to the tune they had been taught.

3.
Of the teaching
of Elephants
and other beasts
to doe divers
tricks.

Of the Elephants, it is said that they may be taught to write; and that purely upon words and commanding them, they will doe what they are bidden; and that they are able to keepe account,

count, and will leave working at a precise number of revolutions of the same action, which measureth out their taske unto them. All which (as I said before) if it were plainely and literally true, would require very great consideration: but because the teachers of beasts have certaine secrets in their art, which standers by doe not reach unto; we are not able (upon such scanty relations as we have of them) to make sufficient judgement how such things are done; unlesse wee had the managing of those creatures, whereby to try them in severall occasions, and to observe what cause produceth every operation they doe; and by what steps they attaine unto their instructions and serviceableness.

It is true, the uncontrolled reports of them, oblige us to believe some extraordinary matter of their docility, and of strange things done by them: but withall, the example of other taught beasts among us, and of the strange judgements that are made of them by persons, who doe not penetrate into their causes, may instruct us how easie it is to mistake the matter; and assure us, that the relations which are made us, doe not alwaies punctually agree with the truth of what passed. He that should tell an Indian what feats Bankes his horse would doe; how he would restore a glove to the due owner; after his master had whispered that mans name in his eare; how he would tell the just number of pence in any piece of silver coyne barely shewed him by his master; and even obey presently his command, in discharging himselfe of his excrements whensoever he bade him (so great a power art may have over nature:) would make him believe admire more at this learned beast, then we doe at their docile Elephants, upon the relations we have of them. Whereas every one of us knoweth, by what meanes his painefull tutor brought him to doe all his tricks: and they are no whit more extraordinary, then a sawknars manning of a hawke, and training her to kill partridges, and to flie at the retrive: but doe all of them (both these, and all other jugling artificies of beasts) depend upon the same, or like principles; and are knowne to be but directions of nature, ordered by one that composeth and levelleth her operations to another end further off (in those actions) then she of her selfe would aime at. The particulars of which, we need not trouble our selves to meddle with.

But:

4.
Of the orderly
traine of acti-
ons performed
by beasts in
breeding their
yong ones.

But it is time that we come to the third sort of actions performed by beasts, which we promised to discourse of. These seem to be more admirable, then any we have yet touched: and are chiefly concerning the breeding of their yong ones. Above all others, the orderly course of birds in this affaire, is most remarkable. After they have coupled they make their nest; they line it with mosse, straw and feathers; they lay their egges, they sit upon them, they hatch them, they feed their yong ones, and they teach them to flie: all which they doe with so continueate and regular a method; as no man can direct or imagine a better.

But as for the regularity, orderlinesse, and continuance of these actions, the matter is easie enough to be conceived: for seeing that the operation of the male, maketh a change in the female; and that this change beginning from the very first, groweth by time into divers proportions: it is no wonder that it breedeth divers dispositions in the female, which cause her to doe different actions, correspondent to those divers dispositions. Now, those actions must of necessity be constant and orderly, because the causes whence they proceed, are such.

But to determine in particular how it commeth to passe, that every change in the female, disposeth her to such and such actions, there is the difficulty; and it is no small one: as well, for that there are no carefull and due observations, made of the effects and circumstances which shou'd guide us to judge of their causes; as because these actions are the most refined ones of sensitive creatures; and doe flow from the top and perfection of their nature; and are the last straine of their utmost vigour, unto which all others are subordinate. As in our enquiry into the motions and operations of the bodies of a lower orbe then these, we meet with some (namely the loadstone, and such like) of which it is very hard to give exact and plaine account; the Author of them reserving something from our cleare and distinct knowledge; and suffering us to looke upon it but through a miste: in like manner we cannot but expect, that in the depth of this other perfecter nature, there must be somewhat whereof we can have but a glimmering and imperfect notion. But as in the other, it served our turne to trace out away, how those operations might be effected by bodies, and by local motion

motion (though peradventure, we did not in every circumstance hit exactly upon the right) thereby to defend our selves from admitting those chymericall qualities, which we had already condemned upon all other occasions.

So I conceive, it will be sufficient for us in this, to shew how these actions may be done by the senses, and by the motion of corporeall spirits and by materiall impressions upon them; without being constrained to resort unto an immateriall principle, which must furnish birds with reason and discourse: in which, it is not necessary for my purpose, to determine precisely every step, by which these actions are performed, and to settle the rigorous truth of them: but leaving that unto those, who shall take pains to deliver the history of their nature, I will content my selfe with the possibility and probability of my conjectures. The first of which qualities, I am obliged to make plain; but the latter concerneth this Treatise no more; then it would do a man to enquire anxiously into the particulars of what it is that a beast is doing, whiles looking upon it at a great distance, he perceiveth plainly that it moveth it selfe: and his arrant is, but to be assured whether it be alive or dead: which the moving of it selfe in common, doth sufficiently demonstrate, without descending into a particular search, of what his motions are.

But let us come to the matter: first I conceive no man will make any difficulty in allowing, that it is the temper of the blood and spirits in birds (brought thereunto by the quality of their food, and by the season of the yeere) which maketh them couple with one another; and not any ayme or desire of having young ones, that occasioneth this action in them. Then it followeth that the hens egges will encrease in her belly; and when they grow big, they cannot choose but be troublesome unto her; and therefore must of necessity breed in her an inclination to rest in some soft place, and to be rid of them. And as we see a dog or a cat pressed by nature, searcheth about to finde a convenient place to disburden themselves in, not onely of their young ones, but even of their excrements; so do birds, whose egges within them, making them heavy and unfit to flie, they begin to sit much and are pleased in a soft and warme place: and thereupon they are delighted with straws and mosse, and other gentle sub-

stances; and so carry them to their sitting place: which that they do not by designe, is evident by the manner of it; for when they have met with a straw or other fit materiall, they flie not with it directly to their nest, but first to a bough of some tree, or to the top of a houſe; and there they hop and dance a while with it in their beakes; and from thence skip to another place, where they entertaine themselves in like manner: and at the last, they get to their nest: where if the straw should lie confusedly, their ends would pricke and hurt them: and therefore they turn and alter their positions till they lie smooth: which we that looke upon the effect, and compare them with our performing of like actions (if we had occasion) may call a judicious ordering of them, whereas in them, it is nothing but removing such things as presse upon their sense, untill they cause them no more paine or unquietnesse.

Their plastering of their nests, may be attributed to the great heat raining in them at that time; which maketh them still be dabbling in moist clay, and in water, and in gravell, (without which, all birds will soon grow sicke, blind, and at length die) which (for the coolnesse of it) they bring home to their nests in their beakes and upon their feet; and when it groweth dry, and consequently troublesome to them, they wipe it off; and rubbe their dirty parts upon the place where they use to sit; and then flie for more to refresh themselves withall.

Out of all which actions (set on foot by the wise orderer of nature, to compass a remote end, quite different from the immediate end that every one of them is done for) there resulteth a fit and convenient place for these little builders (that know not what they doe, whiles they build themselves houses) to lie in; and to lay their egges in. Which the next yeere, when the like occasion occurreth, they build againe; peradventure then, as much through memory of the former, as upon their temper and other circumstances, moving their fantasie, in such sort as we have set downe.

In like manner, that whiles the Halcyon layeth and hatcheth her egges, the sea is calme, needeth no more be attributed to the wisdom and providence of that bird; in choosing a fit season, then to any good nature or discourse in that rouling and mercielesse

lesse Element; as though it had a pious care of preserving the eggs committed to his trust: no such supplements are requisite to be added unto the distributions of nature, who hath set material causes on foot, to produce a conjuncture of both those effects, at the same period of time, for the propagation of this animals species.

In fine, both the time and the place of the Halcyons breeding, and the manner, and order, and reason of all birds making their nests, proceedeth from secret motions, which doe require great observing and attention to understand them; and doe serve for directions unto every bird, according to her kind, to make her nest fittest for her use. Which secret motions, we cannot doubt but are material ones, and doe arise out of the constitution and temper of their bodies and spirits; which in like circumstances are alike in them all: for all the birds of one kind, do make their nests exactly alike; which they would not doe, if this worke proceeded from reason in them, and were governed by their owne election and designe: as we see it happen among men upon all occasions, either of building houses, or of making clothes, or of what action soever is guided by their reason governing their fantasie; in all which we see so great variety and inconstancy.

And therefore this invariability in the birds operations, must proceed from a higher intellect, that hath determinately and precisely ordered a complexe or assembly of sundry causes, to meet infallibly and by necessity, for the production of an effect that he hath designed: and so, the birds are but material instruments to performe without their knowledge or reflexion, a superiour reasons counsels: even as in a clocke, that is composed of severall pieces and wheelles, all the parts of it doe conspire to give notice of the severall effluxes and periods of time, which the maker hath ordered it for.

And although this be a worke of reason and discourse in him, that did set it together; yet the instrumentall performance of it dependeth meerely of locall motion, and of the revolutions of bodies, so orderly proportioned to one another, that their effects cannot faile, when once the engine is wound up: in like manner then, the bird is the engine of the Artificer, infinitely more perfect, and knowing, and dexterious then a poore clock-maker;

maker; and the plummetts which doe make it goe, are the row and order of causes chained together; which by the designe of the supream workman, do bring to passe such effects, as we see in the building of their nests, and in doing such other actions, as may be compared to the striking of the clocke, and the ringing of the alarme at due times.

And as that King of China, upon his first seeing a Watch, thought it a living and judicious creature, because it moved so regularly of it selfe, and believed it to be dead when it was run out; till the opening of it and the winding it up, discovered unto him the artifice of it: so any man may be excused, that looking upon these strange actions, and this admirable oeconomy of some living creatures should believe them endewed with reason, untill he have well reflected upon every particular circumstance of their nature and operations: for then he will discern how these are but materiall instruments of a rationally agent working by them; from whose orderly prescriptions, they have not power to swarve in the least circumstance that is. Every one of which considered singly by it self, hath a face of no more difficulty, then that (for example) an engineer should so order his matters, that a mine should be ready to play exactly at such an houre, by leaving such a proportion of kindled match hanging out of one of the barrels of powder, whiles in the meane time, he either sleepe, or attendeth to something else.

And when you have once gained thus much of your selfe, to gree unto an orderly course and generation of any single effect; by the power of a materiall cause working it; raise but your discourse a straine higher, and looke with reverence and duty upon the immensity of that provident Architect, out of whose hands these masterpieces issue, and unto whom it is as easie to make a chaine of causes of a thousand or of a million of links, as to make one linke alone: and then you will no longer sticke at allowing the whole oeconomy of those actions; to be nothing else, but a production of materiall effects, by a due ranging and ordering of materiall causes.

But let us returne to our theame: as we see that milke coming into the breasts of live-bearing female creatures, when they grow very bigge, heateth and maketh them seeke the mouthes

mouthes of their young ones, to disburthen and coole them: so the carriage and bignesse of the egges, heateth exceedingly the breasts and bodies of the birds; and this causeth them to be still rubbing of their breasts against the sides of their nests (whereunto their unwickdinesse then confineth them very much) and with their beakes to be still picking their feathers; which being then apt to fall off and mew (as we see the haire of women with childe, is apt to shed) it happeneth that by then they are ready to lay their egges, they have a soft bed of their owne feathers, made in their nests, over their courser matrasse of strawes they first brought thither: and then, the egges powerfull attracting of the annoying heat from the hens breast (whose imbibing of the warmth, and stone-like shell, can not choose but coole her much) inviteth her to sit constantly upon them, untill sitting hatcheth them; and it is evident, that this sitting must proceed from their temper at that time, or from some other immediate cause, which worketh that effect, and not from a judgement that doth it for a remote end: for housewives tell us, that at such a season, their hennes will be sitting in every convenient place they come unto, as though they had egges to hatch, when never a one is under them: so as it seemeth that at such time, there is some inconvenience in their bodies, which by sitting is eased.

When the chickens are hatched, what wonder is it, if the little crying of tender creatures, of a like nature and language with their dammes, do move those affections or passions in her bosome, which causeth her to feed them, and to defend, and breed them, till they be able to shift for themselves? For all this there needeth no discourse or reason; but onely the motion of the blood about the heart (which we have determined to be passion) stirred by the young ones chirpings, in such sort, as may carry them unto those actions which by nature (the supreme intellect) are ordered for their preservation. Wherein the birds (as we have already said) are but passive instruments, and know not why they doe those actions: but doe them they must, whensoever such and such objects (which infallibly work in their due times) doe make such and such impressions upon their fantasies, like the allarum that necessarily striketh, when

the hand of the diall commeth to such a point; or the gun-powder, that necessarily maketh a ruine and breach in the wall, when the burning of the match reacheth to it.

Now this love in the dam, growing by little and little wearisome and troublesome to her; and at last, fading quite away; and she not being able to supply their encreased needs, which they grow every day stronger to provide for of themselves; the strait commerce beginneth to dye on both sides: and by these degrees the damme leaveth her yong ones to their owne conduct.

And thus you see how this long *series* of actions, may have orderly causes, made and chained together, by him that knew what was fitting for the worke he went about. Of which, though it is likely I have missed of the right ones (as it can not choose but happen in all disquisitions, where one is the first to breake the yce, and is so slenderly informed of the particular circumstances of the matter in question, as I professe to be in this) yet I conceive this discourse doth plainly shew, that he who hath done more then we are able to comprehend and understand, may have set causes sufficient for all these effects, in a better order, and in compleater ranks, then those which we have here expressed: and yet in them so courselly hewed out, appeareth a possibility of having the worke done by corporeall agents. Surely it were very well worth the while, for some curious and judicious person, to observe carefully and often, the severall steps of nature in this progresse: for I am strongly perswaded, that by such industry, we might in time arrive to very particular knowledge of the immediate and precise causes, that worke all these effects. And I conceive, that such observation needeth not be very troublesome; as not requiring any great variety of creatures to institute it upon; for by marking carefully all that passeth among our homebred hens, I believe it were easie to guesse very neerely at all the rest.

THE EIGHT AND THIRTIETH CHAPTER.

Of prescience of future events, providencies, the knowing of things never seene before; and such other actions, observed in some living creatures; which seems to be even above the reason that is in man himselfe.

THe fourth and last kind of actions, which we may with astonishment observe among beasts, I conceive will avails little to infer out of them, that the creatures which doe them, are endewed with reason and understanding: for such they are, as if we should admit that, yet we should still be as far to seeke for the causes whence they proceed. What should move a lambe to tremble at the first sight of a wolfe? or a hen at a kite never before seene? neither the grimme mastiffe, or the biggest owle, will at all affright them.

That which in the ordinary course of nature, causeth beasts to be afraid of men, or of other beasts, is the hurt and the evill they receive from them: which comming into their fantasie, together with the Idea of him that did it, is also lodged together with it in the memory; from whence they come linked or glewed together, whensoever the stroake of any new object calleth either of them backe into the fantasie. This is confirmed by the tameness of the birds and beasts, which the first discoverers of Islands not inhabited by men, did finde in those they met withall there. Their stories tell us, that at their first arrivall upon those coasts; where it seemeth men had never been, the birds would not flie away, but suffered the mariners to take them in their hands: nor the beasts, which with us are wild, would runne from them; but their discourteous guests used them so hardly, as they soone changed their confidence into distrust and averfion; and by little they grew, by their commerce with men, and by receiving injuries from them, to be as wilde, as any of the like kind in our parts.

1.
Why beasts are
afraid of men.

From the dammes and fires, this apprehension and feare at

the sight of men, so deeply rooted in them, is doubtlesly transmitted to their young ones; for it proceedeth out of the disposition of the body, and out of the passion which is immediatly made in the heart; and that is as truly a materiall motion, as any whatsoever can be; and must have settled materiall instruments fitted to it, if it be constant, as well as any other naturall operation whatsoever: and this passion of the heart, proceedeth againe from a perpetuall connexion of the two objects in the memory: which being a perpetually constant thing, is as true a quality of that beasts braine in whom it is, as the being of a quicke or dull apprehension, or the being apt to know one kinde of meat from another (which is naturall to the whole species) or any other quality whatsoever, residing in that beast.

2.
How some
qualities cau-
ed at first by
chance in
beasts, may
passe by gene-
ration to the
whole off-
spring.

Wherefore it is no wonder, that it passeth by generation to the off-spring: which is a thing so common, even in mankinde, as there can be no doubt of it: and is at the first made by a violent cause, that greatly altereth the body: and consequently their seed must be imbrewed with a like disposition; and so it passeth together with the nature of the sire, or of the dam, into the brood. From hence proceedeth, that children do love the same meates, and exercises, that their fathers and mothers were affected with, and feare the like harmes.

This is the reason, why a grand-childe of my Lord of *Dorset* (whose honoured name must never be mentioned by me, without a particular respect, and humble acknowledgement of the noble and steady friendship, he hath ever been pleased to honor me with) was alwayes extremely sick, if but the Nurse did eate any Capers (against which my Lords antipathy is famous) whiles shee gave suck to that pretty infant. The Children of great Mathematicians, who have been used to busie their fantasies continually with figures and proportions, have been oftentimes observed, to have a naturall bent unto those Sciences. And we may note, that even in particular gestures, and in little singularities in familiar conversation, children will oftentimes resemble their parents, as well as in the lineaments of their faces. The young ones of excellent setting dogges, will have a notable aptitude to that exercise; and may bee taught with halfe

halfe the paines, that their sire or dam was, if they were chosen out of a race of spaniels not trained to setting. All which effects can proceed from no other cause, but (as we have touched already) that the fantasie of the parent, altereth the temper and the disposition of his body and seed, according as it selfe is tempered and disposed: and consequently, such a creature must be made of it, as retaineth the same qualities: in such sort as it is said that sufficient tartar put at the root of a tree, will make the fruit have a winy taste.

But nothing doth confirme this so much, as certain notable accidents, whereof though every one in particular would seeme incredible, yet the number of them, and the weight of the reporters, who are the witnesses, cannot choose but purchase a generall credit to the kinde of them. These accidents are, that out of some strong imagination of the parents, but especially of the mother, in the time of conception, the children draw such maine differences, as were incredible; if the testifying authority were not, so great: but being true, they convince beyond all question the truth wee have proposed, of the parents imagination working upon, and making an impression in the seed; whereof children or young ones of their kinde are made. Some children of white parents are reported to have been black upon occasion of a blacke moores picture too much in the mothers eye. Others are said to have been born with their skins all hairy, out of the sight of St. *John Baptists* picture as hee was in the desert, or of some other hairy image. Another childe is famed to have been borne deformed, in such sort as Devils are painted, because the father was in a Devils habit when hee got the childe.

3.
How the parents fantasie doth oftentimes worke strange effects in their issue.

There was a Lady a kinswoman of mine, who used much to weare black patches upon her face (as was the fashion among young women) which I to put her from, used to tell her in jest, that the next childe she should goe with, whiles the sollicitude and care of those patches was so strong in her fantasie, would come into the world with a great black spot in the middle of its fore-head: and this apprehension was so lively in her imagination at the time she proved with childe, that her daughter was borne marked just as the mother had fantasied, which
there

there are at hand witnesses enough to confirm; but none more pregnant than the young Lady her selfe, upon whom the marke is yet remaining. Among other creatures, it is said that a hen hatched a chicken with a Kites bill, because shee was frightened with a Kite; whiles the Cocke was treading her. The story of *Jacobs* sheepe is knowne to all: and some doe write, that the painting of beautifull coloured pigeons in a dove-house, will make the following race become like them: and in Authors store of such examples may be found.

To give a reasonable and fully satisfying cause of this great effect, I confesse is very difficult; seeing that for the most part, the parents seed is made long time before the accoupling of the male and female: and though it were not, we should be mainly to seeke for a ratiounall ground to discourse in particu^r upon it. Yet not to leave our Reader without a hinte which way to drive his inquisition, we will note thus much, that Aristotle and other naturall Philosophers and Physitians doe affirme, that in some persons the passion is so great in the time of their accoupling, that for the present it quite bereaveth them of the use of reason; and that they are for the while, in a kind of short fit of an epilepsie. By which it is manifest, that abundance of animall spirits doe then part from the head, and descend into those parts which are the instruments of generation. Wherefore, if there be abundance of specieses of any one kind of object then strong in the imagination, it must of necessity be carryed downe together with the spirits into the seed: and by consequence, when the seed infected with this nature, beginneth to separate and distribute it selfe, to the forming of the severall parts of the Embryon, the spirits which doe resort into the braine of the childe (as to their proper Element) and from thence doe finish all the outward cast of its body (in such sort as wee have above described) doe sometimes happen to fill certaine places of the childes body, with the infection and tincture of this object; and that according to the impressi^on with which they were in the mothers fantasie: for so wee have said, that things which come together into the fantasie; doe naturally sticke together in the animall spirits. The hairinesse therefore will be occasioned in those parts, where the Mother fantasied it to
be:

be : the colour likewise, and such extancies or defects, as may any way proceed from such a cause, will happen to be in those parts, in which they were fancied. And this is as farre, as is fit to wade into this point, for so generall a discourse as ours is; and more then was necessary for our turne : to the serving whereof, the verity of the fact onely, and not the knowledge of the cause, was required : for wee were to shew no more, but that the apprehensions of the parents, may descend to the children.

Out of this discourse, the reason appeareth, why beasts have an aversion from those, who use to doe them harme : and why this aversion descendeth from the old ones to their brood ; though it should never have happened that they had formerly encountred with, what at the first sight they flye from and avoid.

But yet the reason appeareth not, why (for example) a sheep in England (where there are no wolves bred, nor have been these many ages) should be afraid, and tremble at sight of a Wolfe, since neither he, nor his damme or sire, nor theirs in multitudes of generations, ever saw a wolfe, or received hurt by any. In like manner, how should a tame weasell brought into England from Ireland (where there are no poysonous creatures) be afraid of a toad as soone as he seeth one? Neither he, nor any of his race, ever had any impressions following harme, made upon their fantasies : and as little can a Lyon receive hurt from a household Cocke : therefore we must seeke the reasons of these and such like antipathies a little further, and we shall find them hanging upon the same string, with sympathies proportionable to them.

Let us goe by degrees : wee daily see that dogges will have an aversion from Glovers, that make their ware of dogs skins : they will barke at them, and be churlish to them, and not endure to come neere them, although they never saw them before. The like hatred they will expresse to the dogge killers in the time of the plague, and to those that flea dogges. I have known of a man that used to be employed in such affaires, who passing sometimes over the grounds neere my mothers house (for hee dwelled at a village not farre off) the dogges

4.
Of Antipa-
thies.

would

would winde him at a very great distance, and would all runne furiously out the way he was, and fiercely fall upon him; which made him goe alwayes well provided for them: and yet hee hath been sometimes hard put to it, by the fierce Mastifes there, had it not been for some of the servants coming in to his rescue; who by the frequent happening of such accidents, were warned to looke out when they observed so great commotion and fury in the dogges, and yet perceived no present cause for it. Warreners observe, that vermin will hardly come into a trap where in another of their kinde hath been lately killed: and the like happeneth in Mouse-traps, into which no Mouse will come to take the baite, if a Mouse or two have already beene killed in; unlesse it be made very cleane, so that no scent of them remaine upon the trap: which can hardly be done on the sudden otherwise then by fire.

It is evident, that these effects are to be referred to an activity of the object upon the sense; for some smell of the skinned, or of the dead dogges, or of the vermine, or of the Mice, cannot choose but remaine upon the men and upon the traps; which being altered from their due nature and temper, must needs offend them. Their conformity on the one side (for something of the canine nature remaineth) maketh them have easie ingression into them; and so they presently make a deep impression: but on the other side, their dis temper from what they should be, maketh the impression repugnant to their nature, and be disliked by them, and to affect them worse, then if they were of other creatures, that had no conformity with them: as we may observe, that stinkes offend us more, when they are accompanied with some weake perfume, then if they set upon us single; for the perfume getteth the stinke easier admittance into our sense: and in like manner, it is said that poysons are more dangerous, when they are mingled with a cordiall that is not able to resist them: for it serveth to convey them to the heart, though it bee not able to overcome their malignitie.

From hence then it followeth, that if any beast or bird doe prey upon some of another kinde, there will be some smell about them, exceedingly noysome to all others of that kinde: and

and not onely to beasts of that same kinde ; but (for the same reason) even to others likewise, that have a correspondance and agreement of temper and constitution with that kinde of beast, whose hurt is the originall cause of this aversion. Which being assented unto, the same reason holdeth to make those creatures, whose constitutions and tempers doe consist of things repugnant and odious to one another, be at perpetuall enmity, and flye from one another at the first sight, or at the least, the sufferer from the more active creature : as we see among those men, whose unhappy trade and continuall exercises it is to empty jakeses, such horrid stinkes are, by time growne so conformable to their nature, as a strong perfume will as much offend them, and make them as sicke, as such stinkes would doe another man bred up among perfumes : and a cordiall to their spirits, is some noysome smell, that would almost poyson another man. And thus, if in the breath of the Wolfe, or in the steame comming from his body, be any quality offensive to the Lambe (as it may very well be, where there is so great a contrariety of natures) it is not strange, that at the first sight and approach of him, he should be distempered and flye from him ; as one fighting cocke will doe from another, that hath eaten garlike : and the same happeneth between the weasell and the toad, the lyon and the cocke, the roade and the spider, and severall other creatures, of whom like enmities are reported.

All which are caused in them, not by secret instincts, and antipathies, and sympathies, whereof we can give no account ; (with the bare sound of which words, most men doe pay themselves, without examining what they meane ;) but by down-right materiall qualities, that are of contrary natures, (as fire and water are) and are either begotten in them in their originall constitution, or are implanted in them afterwards by their continuall food, which nourishing them, changeth their constitution to its complexion. And I am perswaded this would goe so farre, that if one man were nourished continually with such meate (and greedily affected it) which another had aversion from, there would naturally follow much dislike betwene them ; unlesse some superiour regard should matter
this

this averſion of the ſenſe. And I remember to have ſene two notable examples of it : the one in Spaine, of a Gentleman that had a horriour to garlike, who (though he was very ſubject to the impreſſions of beauty) could never weane himſelfe from an averſion he had ſetled him to a very handſomewoman, that uſed to eate much garlik, though to win him, ſhe forbore the uſe of that meate, which to her was the moſt ſavoury of all others. And the like I knew in England between two, whereof the one did extreemly love cheeſe, and the other as much hated it, and would fall into a ſtrange agony, and be reduced (one would thinke) to the point of death, if by inadvertence or others tryall of him, he had ſwallowed never ſo little, of what the other would have quitted all meates elſe to live upon.

And not onely ſuch averſions, as ſpring from differences of complexion in the conſtitutions of ſeverall animals; doe cauſe theſe effects of feare, and of trembling, and of flying from thoſe that do make ſuch impreſſions; but even the ſeeing them angry and in fury doth the like : for ſuch paſſions do alter the ſpirits; and they iſſuing from the body of the animall in paſſion, cannot chooſe but be received by another in a different manner, then if they were of another temper. Then if the one kinde be agreeable to their nature, the other muſt needs be diſpleaſing. And this may be the reaſon why Bees never ſting ſuch as are of a milde and gentle diſpoſition; and will never agree with others, that are of a froward and angry nature. And the ſame one may obſerve among dogges : and peradventure, a mans fantaſie may be raiſed to ſuch a height of fury, that the fierceſt beaſts may be afraid to look upon him; and cannot endure that thoſe maſtering ſpirits, which ſtream out of the mans eyes, ſhould come into his; ſo much they diſtemper his fantaſie : and therefore he will turne away from the man, and avoid him. Which diſcourſe may be confirmed by ſundry examples of Lyons and beares, that have runne from angry and confident men, and the like. Since then, a man that is in his naturall hew giveth no diſtaſte, doth ſo much affright fierceſt beaſtes, when hee putteth on his threatenng lookes; it is no wonder, that beaſtes of a milder and ſofter nature, ſhould have feare of him

him settled in them, when they never saw him otherwise then angry, and working mischief to them. And since their brood do receive from their parents, a nature easily moved unto feare or anger, by the sight of what moved them, it is not strange, that at the first sight they should tremble or swell, according as the inward motion of the spirits affordeth.

Now if this hath rendered the Birds in the wilde Islandes afraid of men, who otherwise would be indifferent to them, it is no marvaile to see more violent effects in the Lambes aversion from the Wolfe, or in the Larkes from the Hobbey; since they peradventure have over and above the hurt they use to do them, a difformity in their constitutions: and therefore, though a Larke will flie as well from a man as from a Hobbey, yet because there is one cause more for his dislike against the Hobbey, then against the man (namely the difformity of their constitutions) hee will flie into the mans hand, to avoid the Hawkes talons.

Unto some of these causes all antipathies may be reduced: and the like reason may be given for the sympathies we see between some creatures. The little corporeities which issue from the one, have such a conformity with the temper of the other, that it is thereby moved to joyn it selfe unto the body from whence they flow, and affecteth union with it in that way, as it receiveth the impression. If the smell do please it, the beast will alwayes be smelling at it: if the tast, nothing shall hinder it from feeding upon it when it can reach it. The fishermen upon the banke over against Newfound Land, do report that there flocketh about them a kind of Bird, so greedy of the fishes livers which they take there, as that to come at them and feed upon them; they will suffer the men to take them in their hands; and will not flie away, as long as any of their desired meate is in their eye: whence the French men that fish there, do call them *Happe Foyes*. The like power, a certaine Worme hath with Nightingales.

And thus you see, how they are strong impressions upon sense, and not any discourse of reason, that do governe beasts in their actions: for if their avoyding men, did proceed from any sagacity in their nature, surely they would exercise it, when they

5.
Of Sympa-
thies.

see

see that for a bit of meate they incurre their destruction : and yet neither the examples of their fellows killed before their eyes in the same pursuite, nor the blowes which themselves do feele ; can serve them for warning; where the sense is so strongly affected : but as soone as the blow that removed them is passed, (if it misse killing or laming them) and they be gotten on wing againe, they will returne to their prey as eagerly and as confidently, as if nothing were there to hinder them.

6. That the Antipathy of Beasts towards one another, may be taken away by assuefaction.

This then being the true reason of all sympathy and antipathy, we cannot admit that any beasts should love or hate one another, for any other cause, then some of those wee have touched. All which are reduced to locall motion, and to materiall application of bodies of one nature, to bodies of another ; and are as well transmitted to their young ones, as begotten in themselves : and as the satisfying of their sense, is more prevalent in the *Happe foyes*, then the feare which from other grounds is begotten in their fantasy ; and so maketh them approach to what the other would drive them from.

In like manner, any averfion of the fantasy may be mastered not onely by a more powerfull agent upon the present sense, but also by assuefaction, and by bringing into the fantasy with pleasing circumstances that object which before was displeasing and affrightfull to it : as we see that all sorts of Beasts or Birds, if they be taken young may be tamed and will live quietly together. Dogges that are used to hunt and kill Deere, will live friendly with one that is bred with them ; and that Fawne which otherwise would have bin affraid of them, by such education groweth confident and playeth boldely with them. Of which we can no longer remaine in doubt, if we will believe the story of a Tyger (accounted the cruelliest beast of all others) who being shut up with a Deere, that had bin bred with him from a Kid and from his being a whelp ; and no meate given him, used meanes to break prison, when he was halfe starved, rather then he would hurt his familiar friend. You will not suspect, that it was a morall consideration, which made him so kinde : but the Deere had never come into his fantasy

tasie accompanied with other circumstances, then of play or of warmth: and therefore hunger (which calleth onely the species of meate out of the memory into the fantasie) would never bring the Deere thither, for remedy of that passion.

And that which often happeneth to those men, in whom the fantasie onely worketh, is not much unlike to this: among whom I have seene some freneticke persons, that if they be perswaded they are tyed, and cannot stirre from the place where they are; they will lye still, and make great complaints for their imprisonment; and not goe a sleepe, to reach any meate or drinke, that should lye in sight neere them, although they were never so much pressed with hunger or with thirst. The reason is evident, for the apprehension of being tyed, is so strong in their fantasie, that their fantasie can send no spirits into other parts of their body, whereby to cause motion.

And thus the deere was beholding to the tygars fantasie, not to his discourse of morall honesty, for his life. The like of this tygar and deere, is to be seene every day in the tower of London; where a little dogge, that was bred with a lyon from his birth, is so familiar and bold with them, that they not onely sleep together, but sometimes the dog will be angry with him, and will bite him; which the lyon never ressenteth from him, though any other dogge that is put to him, he presently teareth in pieces.

And thus we plainly see, how it commeth about, that beasts may have strange aversions from things, which are of annoying or destructive nature to them, even at the first sight of them: and againe, may have great likings of other things, in a manner contrary to their nature, without needing to allow them reason, whereby to discourse and judge what is hurtfull to them or to instruct the tyger we have spoken of, or Androdus his lyon, the duties of friendship and of gratitude.

The longing markes which are oftentimes seen in children, and doe remaine with them all their life, seeme to bee an offspring of the same root or cause: but in truth, they proceed from another, although of kinne to this: for the operation of the seed is passed, when these longing markes are imprinted;

7.
Of longing
markes seen in
children.

the childe being then already formed and quickened; and they seeme to be made suddenly, as by the print of a seale. Therefore to render the cause of them, let us consider another sympathy which is more plain and common. We see that the laughing of one man, will set another on laughing that seeth him laugh, though he know not the cause why the first man laugheth: and the like we see in yawning and stretching, which breedeth the like effect in the looker on. I have heard of a man, that seeing a roasted pigge, after our English fashion with the mouth gaping, could not shut his owne mouth as long as hee looked upon the pigges: and of another, that when he saw any man make a certaine motion with his hand, could not chioose but he must make the same: so that, being a tyler by his trade, and having one hand imployed with holding his tooles, whiles he held himselfe with the other upon the eaves of a house hee was mending, a man standing below on the ground, made that sign or motion to him; whereupon he quitted his holdfast to imitate that motion, and fell downe, in danger of breaking his necke.

All these effects, doe proceed out of the action of the scene object upon the fantasie of the looker on: which making the picture or likenesse of its own action in the others fantasie, maketh his spirits runne to the same parts; and consequently, move the same members, that is, doe the same actions. And hence it is, that when we heare one speake with love and tendernesse of an absent person, we are also inclined to love that person, though we never saw him, nor heard of him before: and that whatsoever a good Oratour delivereth well, (that is, with a semblance of passion agreeable to his words) raiseth of its owne nature, like affection in the hearers: and that generally men learne and imitate (without designe) the customes and manners of the company they much haunt.

To apply this to our intent, it is easie to conceive, that although the childe in the mothers wombe, can neither see nor heare what the mother doth, neverthelesse there can not passe any great or violent motion in the mothers body, whereof some effect doth not reach unto the childe, which is then, one continueate piece with her: and the proper effect of motion or

of trembling in one body, being to produce a like motion or a trembling in another, (as wee see in that ordinary example of tuned strings, whereof the one is moved at the striking of the other, by reason of the stroake given to the ayre; which finding a moveable easily moved with a motion of the same tenour, communicateth motion unto it) it followeth that the fantasie of the childe, being as it were well tuned to the fantasie of the mother, and the mothers fantasie making a speciall and a very quicke motion in her owne whole body, (as wee see that sudden passions doe) this motion or trembling of the mother, must needs cause the like motion and trembling in the childe, even to the very swiftnesse of the mothers motion. Now as we see when one blusheth, the blood cometh into his face, so the blood runneth in the mother to a certaine place, where she is stricken by the thing longed for: and the like happening to the childe, the violence of that sudden motion, dyeth the marke or print of the thing in the tender skin of it: the blood in some measure piercing the skin, and not returning wholly into its naturall course: which effect is not permanent in the mother, because her skinne being harder, doth not receive the blood into it, but sendeth it backe againe, without receiving a tincture from it.

Farre more easie is it, to discover the secret cause of many antipathies or sympathies, which are seen in children, and endure with them the greatest part; if not the whole terme of their life, without any apparent ground for them: (as some doe not love cheefe, others garlike, others ducks, others divers other kindes of meate, which their parents loved well; and yet in token that this aversion is naturall unto them, and not arising from some dislike accidentally taken and imprinted in their fantasie; they will be much harmed if they chance to eat any such meate; though by the much disguising it, they neither know, nor so much as suspect they have done so. The story of the Lady *Henriage* (who was of the bed-chamber to the late Queene *Elizabeth*) that had her cheeke blistered by laying a rose upon it whiles shee was asleepe, to try if her antipathy against that flower, were so great as she used to pretend, is famous in the Court of England. A *Kinsman* of mine, whiles

8.

Why divers men hate some certaine meats, and particularly cheefe.

he was a child, had like to have died of drought, before his nurse came to understand, that he had an antipathy against Beer or Wine; untill the tender nature in him, before he could speak, taught him to make earnest signes for water, that by accident he saw; the greedy drinking of which, cured presently his long languishing and pining sicknesse: and such examples are very frequent.

The cause of these effects many times is, that their mothers, upon their first suppression of their usuall evacuations, by reason of their being with child) took some strong dislike to such things, their stomachs being then oppressed by unnatural humors, which overflow their bodies upon such retentions; and which make them oftentimes sick and prone to vomiting, (especially in the mornings, whiles they are fasting) and sometimes to desire earnestly (which they call *longing*) to feed upon some unwholesome, as well as some particular wholesome things; and other whiles, to take aversion against meates, which at other seasons they affected well. Now the child being nourished by the so imbued blood of the mother, no wonder if it taketh affections or dislikes, conformable to those which at that present raigne in the mother: the which for the most part used to be purged away, or are overwhelmed by the mastering qualities of better aliments succeeding: but if by some mischance, they become too much grafted in the childs stomach, or in some other part, through which the masse of blood must passe; then the child getteth an aversion from those meates: and we often see, that people retaine a strong conversion to such meates or drinks, as their mothers affected much or longed for, whiles they bred child of them.

And thus we will leave this particular; adding only one note, why there are more persons generally, who have antipathy against cheese, then against any one sort of meate besides whatsoever. A principall reason of which symptome (where the precedent one hath not place) I conceive to be, that their nurses proved with child, whiles they gave them suck: for I have by experience found it to have been so in as many as I have made inquiry into. And it is very conformable to reason; for the nurses milk cruddling in her brest upon her breeding of child, and becoming very offensive to the chides tender stomach, (whose being sick,

obaieth

obligeth the parents to change the Nurse, though peradventure they know nothing of the true reason that maketh her milke unnaturall) he hath a dislike of Cheefe (which is strong curdled milk) ever after settled in him; as people that have once surfeited violently of any meate, seldome arrive to brooke it againe.

Now, as concerning those Animals who lay up in store for winter, and seem therein to exercise a rationall providence; who seeeth not, that it is the same humour, which moveth rich misers to heap up wealth, even at their last last, when they have no child nor friend to give it to, nor think of making any body their heires? Which actions because they have no reason in them, are to be imputed to the passion or motion of the materiall appetite. In the doing of them; these steppes may be observed; first the object presenting it selfe to the Eye, provoketh love and desire of it; especially if it be joynd with the memory of former want: then this desire stirreth up the animall (after he hath fed himselfe) to gather into the place of his chief residence, as much of that desired object as he meeteth withall; and whensoever his hunger returning, bringeth back into his fantasy the memory of his meate, it being joynd with the memory of that place (if he be absent from it) he presently repaireth thither, for relief of what presseth him: (and thus Dogs when they are hungry, do rake for bones they had hidden when their bellies were full.) Now if this food, gathered by such providence (which is nothing else, but the conformity of it, working upon him by his sense) and layed up in the place, where the owner of it resideth, (as the corne is, which the Aunts gather in summer) be easily portable, he will carry it abroad with him the first time he stirreth after a long keeping in; for then nothing worketh so powerfully in his fantasy, as his store; and he will not easily part from it, though other circumstances invite him abroad. From hence it proceedeth, that when a faire day cometh after long soule weather, the Aunts, who all that while kept close in their dennes with their corne lying by them, do then come abroad in the Sun, and do carry their graine along with them: or peradventure it happeneth, because the precedent wet weather, hath made it grow hot, or musty, or other-

9.
Concerning
the providence
of Aunts in
laying up in
store for winter.

wife offensive within; and therefore they carry it out, as soon as themselves dare peepe abroad; which is, when the faire weather and heate of the day, inviteth them out into the open ayre: and before night that they returne into their holes, the offensive vapors of the corne are exh'led and dried up, and move their fantasies no longer to aversion, whereupon they carry it back againe; having then nothing but their long contracted love unto it to work upon them. The like whereof men doing by discourse, to ayre their corne, and to keep it sweet, and the same effect following herein, they will presently have it, that this is done by the Aunts, for the same reason, and by designe. Then the moysture of the earth swelling the graine, and consequently, making it begin to shoot at the ends (as we declared, when we spoke of the generation of plants, and as we see in the moystening of corne to make malt of it) those little creatures, finding that part of it more tender and juycy then the rest, do nibble upon it there, and do feed themselves first with that, which consequently hindereth the groweth of the corne. And here againe, men will contend that this must be done by providence and discourse, to prevent that their store should not grow out of their reach, and changing nature, become uselesse to them in their need.

10. Concerning the foreknowing of Beasts.

To conclude, the foreknowing of beasts is nothing else, but their timely receiving impressions, from the first degrees of mutation in things without them; which degrees are almost imperceptible to us, because our fantasies and spirits, have otherwise such violent agitations, more then theirs, which hinder them from discerning gentle impressions upon them. If you be at Sea, after a long calme, a while before a gale bloweth to fill your sailes, or to be discernable by your sense in quality of wind, you shall perceive the Sea begin to wrinkle his smooth face that way the wind will come; which is so infallible a signe that a gale will come from that coast, as mariners immediately fall to trimming their sailes accordingly; and usually, before they can have done, the wind is with them: shall we therefore say that the Sea hath a providence to foresee which way the wind will blow? Or that the cornes upon our toes, or calluses, or broken bones or joynts that have been dislocated, have discourse, and can fore-

tell,

tell the weather? It is nothing else, but that the wind rising by degrees, the smooth Sea is capable of a change by it, before we can feele it: and that the Aire, being changed by the forerunners of worse weather, worketh upon the crasfiest parts of our body, when the others feele not so small a change: so beasts are more sensible then we (for they have lesse to distract them) of the first degrees of a changing weather: and that mutation of the Aire wit^hout them, maketh some change within them, which they expresse, by some outward actions or gestures.

Now they who observe, how such mutations and actions are constantly in them, before such or such weather, do think they know beforehand, that raine (for example) or wind, or drought is coming, according to the severall signes they have marked in them: which proceedeth out of the narrownesse of their discourse, that maketh them resort to the same causes, whensoever they meet with like effects: and so they conceive, that things must needs passe in beasts, after the same tenour, as they do in men. And this is a generall, and maine errour, running through all the conceptions of mankind, unlesse great heed be taken to prevent it, that what subject soever they speculate upon, whether it be of substances, that have a superiour nature to theirs, or whether it be of creatures inferiour to them, they are still apt to bring them to their own standard, and to frame such conceptions of them, as they would do of themselves: as when they will have Angels discourse, and move, and be in a place, in such sort as is naturall to men; or when they will have beasts rati- onate and understand, upon their observing some orderly actions performed by them, which in men would proceed from dis- course and reason. And this dangerous Rock (against which many fine conceptions do suffer shipwrack) whosoever studieth truth, must have a maine caution to avoyde.

Sed nos immensum spatium confecimus equor:

Et jam tempus equum sumantia solvere colla.



THE
C O N C L U S I O N
 OF THE
FIRST TREATISE.

THus at the last (by Gods assistance) we have climbed up to the top of the hill; from whence looking downe over the whole region of bodies, we may delight our selves, with seeing what a height the weary steps we ascended by, have brought us unto. It is true, the path we have walked in, is of late so untrodden, and so overgrowne with bryars, as it hath not been without much labour, that we have made our way through. And peradventure, it may seem toyle some unto others to follow us, especially such as are not much enured to like journeys: but I hope, the fruit which both we, and they are now arrived to gather of our paines, in this generall view we have taken of the empire of matter, and of corporeall agents, is such, as none of us hath reason to be ill satisfied with the employing of them. For what can more powerfully delight, or more nobly entertaine an understanding soule, then the search and discovery of those workes of nature, which being in their effects so plainly exposed to our eyes, are in their causes so abstruse and hidden from our comprehension, as (through despaire of successe) they deter most men from enquiring into them?

And

And I am perswaded, that by this summary discourse (short indeed, in regard of so large a scope, how ever my lame expressions may peradventure make it appeare tedious) it appeareth evidently, that none of natures greatest secrets, whereof our senses give us notice in the effects, are so overshadowed with an impenetrable veile, but that the diligent and wary hand of reason might unmaske them and shew them to us, in their naked and genuine formes, and delight us with the contemplation of their native beauties; if we had as much care and constancy in the pursuit of them, as wee daily see men have in heaping up of wealth, or in striving to satisfie their boundlesse ambitions; or in making their senses swimme in the muddy lake of base and contemptible pleasures. For who shall thoroughly consider and weigh what we have hitherto said, will plainly see a continuall and orderly progresse, from the simplest, highest, and most common conception, that we frame of a body in generall, unto the furthest and most abstruse effects, that in particular are to be found in any body whatsoever: I meane, any that is meereley corporeall, without mixture of a nobler nature; for hitherto we have not moved, nor so much as looked out of that Orbe: He shall finde one continued thread, spunne out from the beginning to the end. He will see, that the various twisting of the two specieses of *Bodies, Rare, and Dense*, do make the yarne, of which all things and actions within the sphere of matter are woven.

And although peradventure, in the drawing out of the thread, there may be some little brackes, or the stufte made of it be not every where so close wrought, as a better workman at more leisure might have done; yet truly, I believe, that the very consent of things throughout is such, as demonstrateth, that the maine contexture of the doctrine I have here touched, is beyond quarrelling at. It may well be that in sundry particulars, I have not lighted upon exact truth: and I am so farre from maintaining peremptorily any thing I have here said, as I shall most readily hearken to whatsoever shall be objected against it; and be as ready upon cause, to desert my owne opinions, and to yeeld unto better reason. But withall, I conceive,

ceive, that as the falling of a bricke here and there in the repairing of the walls of a house, doth nothing at all prejudice the strength and security of the fabricke; no more (I hope) will the slight escapes, which so difficult a taske as this is subject unto, endamage or weaken the maine body of what I have here delivered. I have not yet seen any piece upon this subject, made up with this method, beginning from the simplest and plainest notions, and composing them orderly, till all the principall variety which their nature is capable of, bee gone through: and therefore it cannot be expected, but that the first modell of this kinde (and moulded by one distracted with continuall thoughts of a much different straine; and whole exercise, as well as profession, hath allowed him but little commerce with bookes and study) must needs be very rough hewed, and require a great deal of polishing. Which whosoever shall do, and be as exact and orderly in treating of Philosophy and Theology, as Mathematicians are in delivering their sciencies, I doe assure my selfe that *Demonstrations* might be made, and would proceed in them as currently, and the conclusions be as certaine and as full, as in the Mathematickes themselves. But that is not all: these demonstrations would have the oddes exceedingly of the other, and bee to us, inestimably more advantageous: for out of them, doe spring much higher and nobler effects, for mans use and life, then out of any Mathematicall ones; especially when they extend themselves to the government of *Man* as he is *Man*: which is an art, as farre beyond all the rules of Physicke, or other government of our body, or temporall goods, as the end is beyond the meanes wee employ to gaine it; for all the others, doe but serve instrumentally to this end, *That wee may live well*: whereas these doe immediately teach it.

These are the fruits in generall, that I hope may in some measure, grow out of this discourse, in the hands of equall and judicious Readers: but the particular ayme of it, is to shew what actions can proceed from a body, and what cannot. In the conduct whereof, one of our chiefe endeavours, hath beene to shew, that those actions which seeme to draw strongly in-

to the order of bodies, the unknown nature of certaine entities named *Qualities*; either doe or may proceed, from the same causes, which produce those knowne effects, that all sides agree, doe not stand in need of any such mysticall Philosophy. And this being the main hinge upon which hangeth and moveth the full and cleare resolving of our maine, and great question, *Of the immortality of the soule*; I assure my selfe, the paines I have taken in this particular, will not be deemed superfluous or tedious: and withall, I hope I have employed them with so good successe, as henceforward, wee shall not be any more troubled, with objections drawne from their hidden and incomprehensible nature: and that we stand upon even ground, with those of the contrary opinion: for since we have shewed, how all actions may be performed among bodies, without having any recourse to such *Entities* and *Qualities* as they pretend and paint out to us, it is now their part (if they will have them admitted) to prove that in nature there are such.

Having then brought the Philosophy of bodies unto these termes; that which remaineth for us to performe, is to shew that those actions of our soule, for which we call her a spirit, are of such a nature, as they cannot be reduced into those principles, by which all corporeall actions are effected. For the proof of our originall intent, no more then this, can be exacted at our hands; so that if our positive proofes, shall carry us yet beyond this, it cannot be denied; but that we give over measure, and doe illustrate with a greater light, what is already sufficiently discerned. In our proceeding, we have the precedencie of nature: for laying for our ground; the naturall conceptions which mankind maketh of quantity; we finde that a body is a meere passive thing, consisting of divers parts, which by motion may be diversly ordered; and consequently, that it is capable of no other change or operation, then such as motion may produce; by various ordering the divers parts of it: and then, seeing that *Rare* and *Dense*, is the primary and adequate division of *Bodies*; it followeth evidently that what cannot be effected by the various disposition of rare and dense parts, cannot proceed or be effected by a pure
body

body : and consequently, it will bee sufficient for us to shew, that the motions of our soules are such : and they who will not agree to this conclusion, must take upon them to shew, that our first premissis defective ; by proving that other unknowne waies are necessary, for bodies to be wrought upon, or to worke by : and that the motion, and various ordering of rare and dense parts in them, is not cause sufficient for the effects we see among them. Which whosoever shall attempt to do, must remember that he hath this disadvantage before he beginneth, that whatsoever hath been hitherto discovered in the science of bodies, by the help either of Mathematicks or Physicks, it hath all been resolved, and hath falne into this way which we declare.

Here I should set a period to all further discourse concerning this first Treatise of bodies, did I not apprehend, that the prejudice of Aristotles authority, may dispose many to a harsh conceit of the draught we have made. But if they knew how little reason they have to urge that against us, they would not cry us downe for contradicting that Oracle of nature : not onely because he himselfe, both by word, and by example, exhorteth us, when verity leadeth us another way, to forsake the trackes which our forefathers have beaten for us, so we doe it with due respect and gratitude for the much they have left us : nor yet because Christian Religion, as it will not heare of any man (purely a man) free from sinne, so it inclineth to periwade us, that no man can be exempt from error ; and therefore it savoureth not well, to defend peremptorily any mans sayings (especially if they be many) as being uncontrollable ; howbeit I intend not to prejudice any person, that to defend a worthy Authors honour, shall endeavour to vindicate him from absurdities and grosse errors : nor lastly, because it hath ever been the common practise of all grave Peripateriks and Thomists, to leave their Masters, some in one article, some in another : but indeed, because the very truth is, that the way we take, is directly the same solid way, which Aristotle walked in before us : and they who are scandalised at us for leaving him, are exceedingly mistaken in the matter : and out of
the

the sound of his words (not rightly understood) do frame wrong sense of the doctrine he hath left us, which generally we follow.

Let any unpariall Aristotelian answer, whether the conceptions we have delivered of *Quantity*, of *Rarity* and *Density*, of the *four first Qualities*, of the *combinations* of the *Elements*, of the *repugnance of vacuities*, be not exactly and rigorously Aristotles? Whether the motion of weighty and light things, and of such as are forced, be not by him, as well as by us, attributed to externe causes? In which all the difference betweene us is, that we enlarge our selves to more particulars then he hath done. Let any man read his bookes of *Generation* and *Corruption*, and say whether he doth not expressely teach, that mixtion (which he delivereth to be the generation or making of a mixt body) is done *per minima*; that is in our language and in oneword, by atomes; and signifyeth, that all the qualities, which are naturall qualities following the composition of the Elements, are made by the mingling of the least parts or atomes of the said Elements; which is in effect to say, that all the nature of bodies, their qualities, and their operations, are compassed by the mingling of atomes: the shewing and explicating of which, hath beene our labour in this whole Treatise. Let him read his bookes of *Meteors*, and judge whether he doth not give the causes of all the effects he treateth of there, by mingling and separating of great and little, grosse and subtile, fiery and watery, ayery and earthy parts, just as we doe. The same he doth in his *Problems*, and in his *Parva naturalia*, and in all other places, wheresoever he hath occasion to render Physically, the causes of Physicall effects. The same doe Hippocrates and Galen: the same, their Master Democritus; and with them the best sort of Physitians: the same doe Alchymistes, with their master Geber; whose maxime to this purpose, we cited above: the same doe all naturall Philosophers, either ancient commentatours of Aristotle, or of moderne enquirers into naturall effects, in a sensible and understandable way: as who will take the paines to look into them, will easily perceive. Wherefore, let any judicious Reader that hath looked further into Aristotle then onely upon

upon his Logicall and Metaphysicall workes; judge whether in *bulke* our Doctrin bee not conformable to the course of his, and of all the best Philosophers that have beene and are; though in *detalle* or particulars, we sometimes mingle therewith, our owne private judgements: as every one of them, hath likewise shewed us the way to doe, by the liberty themselves have taken to dissent in some points from their predecessours.

And were it our turne, to declare and teach Logike and Metaphisickes, we should be forced to goe the way of *matter*, and of *formes*, and of *privations*, in such sort as Aristotle hath trodden it out to us, in his workes of that straine. But this is not our taske for the present; for no man that comtemplateth nature as he ought, can choose but see that these notions are no more necessary, when we consider the framing of the elements; then when we examine the making of compounded bodies: and therefore, these are to be set apart, as higher principles, and of another straine, then need be made use of for the actuall composition of compounded things, and for the resolution of them in their materiall ingredients, or to cause their particular motions; which are the subjects we now discourse of.

Upon this occasion, I thinke it not amisse to touch, how the latter sectatours, or rather pretenders of Aristotle; (for truly they have not his way) have introduced a modell of doctrine (or rather of ignorance) out of his words; which he never so much as dreamed of; howbeit they alledge texts out of him to confirme what they say; as Heretickes doe out of Scripture to prove their assertions: for whereas he called certaine collections or positions of things, by certaine common names (as the art of Logicke requireth) terming some of them *Qualities*, others *Actions*, others *Places*, or *Habites*, or *Relatives*, or the like: these his latter followers, have concei- red that these names did not designe a concurrence of sundry things, or a divers disposition of the parts of any thing; out of which some effect resulted; which the understanding considering all together, hath expressed the notion of it by one name

name: but have imagined, that every one of these names had correspondent unto it; some reall, positive entity, or thing, seperated (in its owne nature) from the maine thing or substance in which it was, and indifferent to any other substance; but in all unto which it is linked, working still that effect, which is to be expected from the nature of such a *quality*, or *action*, &c. And thus, to the very negatives of things; as to the names of points, lines, instants, and the like, they have imagined positive Entities to correspond: likewise, to the names of *actions*, *places*, and the like, they have framed other Entities: as also to the names of *colours*, *sounds*, *tastes*, *smells*, *touches*, and the rest of the *sensible qualities*, they have unto every one of them, allotted speciall Entities, and generally to all qualities whatsoever. Whereas nothing is more evident, then that Aristotle meant by *qualities* no other thing, but that disposition of parts, which is proper to one body, and is not found in all: as you will plainly see, if you but examine, what *beauty*, *health*, *agility*, *science*, and such other qualities are; (for by that name he calleth them; and by such examples, giveth us to understand what he meaneth by the word *Quality*) the first of which is nothing else but a composition of severall parts and colours: in due proportion to one another: the next, but a due temper of the humours, and the being of every part of the body, in the state it should be: the third, but a due proportion of the spirits and strength of the sinews: and the last, but ordered Phantasmes.

Now when these perverters of Aristotle have framed such Entities, under that conception which nature hath attributed to substances, they doe immediately upon the nicke, with the same breath that described them as substances, deny them to be substances: and thus they confound the first apprehensions of nature, by seeking learned and strained definitions for plaine things. After which, they are faine to looke for glew and patte to joyne these entities unto the substance they accompany: which they finde with the same facility, by imagining a new entity, whose nature it is to doe that which they have need of.

And

And this is the generall course of their Philofophy ; whose great subtilty , and queint spéculations in enquiring how things doe come to passe afford no better satisfaction then to say upon every occasion , that there is an *entity* which maketh it be so. As if you aske them , how a *wall is white, or blacke* ? They will tell you , there is an *Entity* or *Quality* , whose essence is to be *whitensesse* or *blacknesse* , diffused through the wall. If you continue to aske , how doth whitensesse sticke to the wall ? They reply , that it is by meanes of an *Entity* called *Union* , whose nature it is actually to joyne whitensesse , and the wall together. And then if you enquire how it commeth to passe , that one white is like another ? They will as readily answer that this is wrought by another *Entity* , whose nature is to be *likenesse* , and it maketh one thing like another. The consideration of which doctrine , maketh me remember a ridiculous tale of a trewant schoolboyes latine : who upon a time when he came home to see his friends , being asked by his father , what was latine for *bread* ? answered *breadibus* ; and for *beer* ? *beeribus* ; and the like of all other things he asked him , adding onely a termination in *ibus* , to the plaine English word of every one of them : which his father perceiving , and (though ignorant of Latine) yet presently apprehending , that the mysteries his sonne had learned , deserved not the expence of keeping him at schoole , bad him immediately put off his *hosibus* and *shoosibus* , and fall to his old trade of treading *Mortaribus*. In like manner , these great Clerks do as readily finde a pretty *Quality* or mood whereby to render the nature or causes of any effect in their easie Philofophy , as this Boy did a *Bus* to stamp upon any English word , and coyne it into his mocklatine.

But to be serious , as the weight of the matter requireth , let these so peremptory pretenders of Aristotle , shew me but one text in him , where he admitteth any middle distinction (such as those moderne Philosophers doe , and must needs admit , who maintaine the qualities we have rejected) betwixt that which he calleth *Numericall* , and that which he calleth of *Reason* , or of *Notion* , or of *Definition* , (the first of which we may terme to be of , or *in things* ; the other to be *in our heads* , or *discourses* : or the

One *Naturall*, the other *Logicall*:) and I will yeeld that they have reason, and that I have grossely mistaken what he hath written, and that I doe not reach the depth of his sense. But this they will never be able to do.

Besides the whole scope of his doctrine, and all his discourses and intentions, are carryed throughout, and are built upon the same foundations, that we have laid for ours. Which being so, no body can quarell with us for Aristotles sake; who as he was the greatest Logician, and Metaphysician, and universall Scholler peradventure that ever lived; and was so highly esteemed, that the good turne which *Syha* did the world in saving his workes, was thought to recompence his many outrageous cruelties and tyranny; so his name must never be mentioned among schollers, but with reverence, for his unparalleled worth; and with gratitude, for the large stocke of knowledge he hath enriched us with. Yet withall we are to consider, that since his reign was but at the beginning of sciences, he could not choose but have some defects and shortnesses, among his many great and admirable perfections.

THE SECOND
TREATISE:
DECLARING,
THE NATURE
AND
OPERATIONS
OF
MANS SOULE;
OUT OF WHICH,
THE IMMORTALITY
OF
REASONABLE SOULES,
IS CONVINCED.

Pro captu Lectoris, habent sua fata libelli.

LONDON,
Printed in the yeere 1645.

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TREATISE
DECLARING
THE NATURE
AND
OPERATIONS
OF
MANS SOUL;
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THE IMMORTALITY
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IS CONVINCED.

Proprietors, London, in Great Britain.

LONDON

Printed in the year 1675.

THE PREFACE.

they call the Powers of Seeing, of Hearings, of Smelling, &c. and the like of many others. But latter Philosophers, being very disputative, and desiring to seeme ignorant of nothing (or rather, to seeme to know more then any that are gone before them, and to refine their conceptions) have taken the notions, which by our first Masters were set for common and confused explications of the natures, (to serve for conveniency and succinctnesse of discourse) to bee truly and really particular Entities, or things of themselves: and so have filled their Bookes, and the Schooles, with unexplorable opinions; out of which no account of nature can be given: and which is worse, the way of searching on, is barred to others; and a mischievous error is growne into mens believes, that nothing can be knowne. By this means they have choaked the most plaine and evident definition of a Body, bringing so many instances against it; that univary men are forced to desert and deny the very first notions of nature and reason: for in truth, they turne all bodies into spirits, making (for example) heate, or cold, to be of it selfe indivisible, a thing by it selfe, whose nature is not conceivable; not the disposition or proportion of the parts of that body which is said to be hot or cold; but a reall thing, that hath a proper Being and nature peculiar to it selfe; whereof they can render you no account: and so may as well be against the notion of a body as not: for if light, the vertue of the loadstone, the power of seeing, feeling, &c. be things that worke without time, in an instant; if they be not the dispositions of parts as parts, (whose nature is, to be more or lesse, to be next or farre off, &c.) how can it be truly said, that the notion of a body, is to be of parts? For if this be a true definition of a body, it followeth that all corporeall qualities and actions must likewise be some disposition and order of parts, as parts: and that what is not so, is no body, nor bodily quality or propriety.

This

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This then was it that obliged mee to go so farre about, and to shew in common, how all those effects, which are so much admired in bodies, are, or may be made and continued by the sole order of quantitative parts and locall motion: this hath forced us to anatomize nature, and to beginne our dissection, with what first occurreth unto our sense from a body. In doing which, out of the first and most simple notion of Biggenesse or Quantity, we found out the prime division of Bodies, into rare and Dense: then finding them to be the Qualities of dividing and of being divided (that is, of locall motion) wee gained knowledge of the common properties of Gravity and Levity: from the combination of these, wee retrived the foure first Qualities: and by them, the Elements. When wee had agreed how the elements were made, we examined how their action and composition raiseth those second qualities, which are seene in all mixt bodies, and do make their divisions. Thence proceeding into the operations of life, wee resolved they are composed and ordered meerey by the varieties of the former: nay, that sense and fantasy (the highest things we can discern out of man) have no other source, but are subject to the Lawes of parts and of Rarity and Density; so that in the end wee became assured of this important Maxime: That nothing whatsoever wee know to bee a Body, can be exempted from the declared Laws, and orderly motions of Bodies: unto which, let us adde two other positions, which fell also within our discovery: the first that it is constantly founded in nature, that none of the bodies we know, do move themselves; but their motion must be founded in some thing without them: the second, that no body moveth an other, unlesse it selfe be also moved: and it will fallow evidently out of them, (if they be of necessity and not prevaricable) that some other Principle

beyond

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beyond bodies, is required to be the roote and first ground of motion in them: as Mr. White hath most acutely and solidly demonstrated, in that excellent worke I have so often cited in my former Treatise.

But it is time we should fall to our intended discourse, leaving this point settled by what we have already said, that if we shew our soule, and her operations, to be not composed of parts, we also therein conclude, that she is a spirituall substance, and not a body. Which is our designe and intention in this Treatise.

Dialog. 3.^o.
Nodo 2.^{do}.

And for this intent we must look upon those actions of men, which are peculiarly his: and upon those things which result out of them, and are called, Opera or labores hominum; as Houses, Townes, Tillage, Handicrafts, Armes, Shippes, Common-wealthes, Armies, Bookes, and the like; in which great mens lives and thoughts have beene spent. In all these wee find one generall thred, to run quite through them; and that all of them are composed of the same stuffe, and are built upon the same foundation: which is, a long chaine of discourses, whereof every little part or link is that which schollers do call a Syllogisme: and Syllogismes we know are framed of enuntiations; & they of single or uncomposed apprehensions. All which are actions wrought by the understanding of a man. But beyond these, we cannot proceed to any further subdivision of parts, and continue our selves within the Orbe of human Actions; for simple apprehensions cannot be further resolved into other parts, beyond the degree of apprehensions, and yet still remaine actions peculiar to a man: so that wee may be sure, we shall have left nothing out of enquiry, concerning Mans actions as he is Man, if we begin with anatomizing his first bare apprehensions; and so go on by degrees, compounding them, till we come to saddome those great and admirable machines of books and works, which he (as I may say) weaveth

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meaveth out of his own bowells; and the like of which is done by no other creature whatsoever, upon the face of our contemptible Earth.

These then (which are all comprised under the names of Apprehensions, of Enunciations or Judgements, and of Discourses) shall be the subject of this second Treatise: and in it, we will first consider these operations in themselves; which being done, we will endeavour to prove out of the nature and manner of performing them, that the soules unto whom they belong, are Immaterial and Immortall.



...the nature of the soules, and the manner of their operations, shall be the subject of this second Treatise: and in it, we will first consider these operations in themselves; which being done, we will endeavour to prove out of the nature and manner of performing them, that the soules unto whom they belong, are Immaterial and Immortall.



THE SECOND TREATISE:

DECLARING

The nature and operations of Mans Soule.

THE FIRST CHAPTER.

Of simple Apprehensions.

THat we may duly understand, what a right Apprehension is, let us consider the preeminence that a man who apprehendeth a thing rightly, hath over him who misseth of doing so. This latter can but rove wildly at the nature of the thing he apprehendeth; and will never be able to draw any operation into act, out of the apprehension he hath framed of it. As for example: if a man be to work upon gold, and by reason of its resemblance unto brasse; hath formed an apprehension of brasse, instead of an apprehension of gold, and then (knowing that the action of fire, will resolve brasse into its least parts, and sever its moist from its dry ones) will go about to calcine gold in the same manner as he would do brasse; he will soon find that he loseth his labour; and that ordinary fire is not an adequate Agent to destroy the homogeneall nature, and to sever the minute parts of that fixed mettall: all which happeneth, out of the wrong apprehension he hath made of gold. Whereas on the other side, he that apprehendeth a thing rightly, if he pleaseth to discourse of what he apprehendeth, findeth in his apprehension all the parts and qualities, which are in the thing he discourseth of: for example, if he apprehendeth rightly a knife, or a beetle, or a sive, or any other thing whatsoever; in the *knife* he will find *hast* and *blade*; the blade of iron, thick on the back, and thin on the edge; tempered to be hard and tough; thus beaten, so ground, in such manner softned, thus quenched, and whatsoever else concerneth

I.
What is a right apprehension of a thing.

neth the Being or the making of a knife : and all this he draweth out of his notion or apprehension of a knife ; which is, *that it is an instrument fitted to cut such and such things, in such a manner*: for hence he findeth, that it hath an haft, fit to hold it by in ones hand, to the end it may not hurt the hand, whiles it presseth upon the knife ; and that the blade is apt to slide in betwixt the parts of the thing which is to be cut, by the motion of being pressed or drawne by the hand : and so he proceedeth on, descending to the qualities of both parts ; and how they are to be joyned, and held fast together. In the like manner, he discourseth of a beetle, of a sive, or of whatsoever else commeth in his way. And he doth this, not onely in such manufactures as are of mans invention ; but (if he be capable) he doth the like in beasts, in birds, in trees, in herbes, in fishes, in fossiles, and in what creature soever he meeteth withall, within the whole extent of nature. He findeth what they are made for : and having discovered Natures time in their production, he can instruct others, what parts and manner of generation they have, or ought to have : and if he that in this manner apprehendeth any thing rightly, hath a mind to work upon it, either to make it, or to use and order it to some end of his owne ; he is able by his right apprehension, to compare it unto other things ; to prepare what is any way fitting for the making of it ; to apply it unto what it will work its effect upon ; and to conserve it from what may wrong or destroy it : so, if he have framed a right apprehension of a sive, he will not employ it in drawing water ; if of a beetle, he will not goe about to cut with it ; neither will he offer, if he have a due apprehension of a knife, to cut stone or Steele with it, but wood, or what is softer. He knoweth what will whet and maintain the edge of it ; and understandeth what will blunt or break it : In fine, he useth it in such sort, as the knife it self (had it knowledge and will) would wish to be used ; and moveth it in such a manner, as if it had power of motion, it would move it self : he goeth about the making it, even as nature would do, were it one of her plants : and in a word, the knife in this apprehension made in the man, hath those causes, proprieties, and effects, which are naturall unto it ; and which nature would give it, if it were made by her ; and which are proportionable to those parts, causes, proprieties, and effects, that nature bestoweth on her children and creatures, according to their severall essences.

What

What then can we imagine, but that the very nature of a thing apprehended, is truly in the man, who doth apprehend it? And that to apprehend ought, is to have the nature of that thing within ones selfe? And that man, by apprehending, doth become the thing apprehended; not by change of his nature unto it, but by assumption of it unto his?

2.

The very thing it selfe is truly in his understanding who rightly apprehendeth it.

Here peradventure some will reply, that we presse our inference too far: and will peremptorily deny the things reall being in our mind, when we make a true and full apprehension of it; accounting it sufficient for our purpose, that some likenesse, or image of the thing be there; out of which, we may draw all these, whether contemplations, or workes, or disposals of the thing. But by that time this objection is throughly looked into, and that so much as they allow is duly examined, I beleeve we shall find our quarrell to be onely about the word, not about the matter: and that indeed, both of us do mean the same, howbeit diversly conceived: and that in substance their expression, in what they grant, importeth the same as ours doth: which, it is true, they first deny in words; but that may be, because the thing is not by them rightly understood.

Let us then discusse the matter particularly. What is likenesse, but an imperfect unity between a thing, and that which it is said to be like unto? If the likenesse be imperfect, it is more unlike then it is like unto it: and the liker it is, the more it is one with it; untill at length, the growing likenesse may arrive to such a perfection, and to such an unity with the thing it is like unto, that then, it shall no longer be like, but is become wholly the same, with that formerly it had but a resemblance of. For example, let us consider, in what consisteth the likenesse unto a man, of a picture drawne in black and white representing a man: and we shall find, it is onely in the proportion of the limbes and features; for the colours, the bulke, and all things else are unlike; but the proportions are the very same, in a man and in a picture; yet that picture is but a likenesse, because it wanteth bignesse and colour: give it them, and neverthelesse it will bee but a likenesse, because it wanteth all the dimensions of corporeity or bulk, which are in a mans body: adde also those to it; & still it will be but a likenesse or representation of a man, because it wanteth the warmth, the softnesse, and the other qualities

of a living body, which belong to a man : but if you give it all these, then it is no longer a likeness or image of a living creature, but a living creature indeed ; and if peradventure this living creature doe continue still to be but the likeness of a man, it is because it wanteth some perfections or proprieties belonging to a man : and so in that regard, is unlike a man : but if you allow it all those, so that in nothing it be unlike, then your taking away all unlikenesse, taketh away likeness too : and as before of dead, it became a living creature, so now of another living creature, it becommeth a man, and is no longer like a man. You see then plainly the reason, why that, which wee call a *like thing*, is not *the same* ; for in some part it is dislike : but if the likeness were compleat in every regard, then it were no longer to be called *like*, but the very thing it selfe : and therefore wee may conclude, that if the likeness of a thing, which the objection alloweth to be in our knowledge, doe containe all that is in the thing knowne, then it is in truth, no more a likeness, but the very knowne thing it selfe : and so what they grant, amounteth to as much as we require ; though at the first they goe about to exclude it.

3. Having thus concluded, that when we apprehend any thing, that very thing is in us ; let us in the next place examine, how it commeth thither, and what it is there. Which we shall best doe, by anatomising, and looking narrowly into the nature of such apprehensions, as we daily make of things. It is true, we said even now, that we cannot divide the actions of mans mind, further then into apprehensions ; and therefore we called them simple and uncomposed : and with good reason ; for if we reflect upon the operations of our mind, we shall evidently perceive, that our bare apprehensions, and onely they, are such : but withall we must acknowledge, that all the apprehensions we make of things comming unto us by our senses, are composed of other more single apprehensions, and may be resolved into them : all which are as it were the limbs and parts, that make up and constitute the other totall one.

4. Let us make use of our former example, and dissect the apprehension we make of a knife : I find in my understanding that it is a thing so long, so broad, so sharp, so heavy, of such a colour, so moulded, so tempered, &c. as is fit to cut withall. In this totall apprehension of a *being* is the most simple and *basiss* of all the rest.

apprehension, I discover three kinds of particular apprehensions, every one more simple and refined then the other. The highest of them, and the foundation upon which the others are built, is the notion of *Being*: which is of so high, and of so abstracted a nature; that we cannot retrieve words to expresse in what manner we conceive it; but are faine to content our selves with the outward sound of a word, by which, without describing our owne, we stir up the like conception in another: and that is the word *Is*; by which we intimate the *Being* of the thing we apprehend. And this notion can be in our mind, without inferring any other; and therefore is the simplest of all others: which, of necessity, must imply it, and cannot be without it, although it can be without them.

Our next apprehension is of that which hath *Being*: and is expressed by the word *Thing*. This is not so simple as the former; for it is composed of it, and of what receiveth it; of *Being*, and of *what hath Being*: yet it is much simpler then the next degree of apprehensions, which is caused in our mind by the great variety of things, that come thither through our senses; and can be conceived without any of them, though none of them can without it; for I can have in me the motion of *a thing*, abstracting from all accidents whatsoever; as of magnitude, of figure, of colour, of resemblance, or the like: but I cannot conceive it to be long, or sharp, or blew, &c. without allowing it first to be *somewhat* or *something*, that is in such sort affected: so that the apprehension of *a thing*, or of that which hath *Being*, is the Basis of all our other subsequent apprehensions; as the apprehension of *Being*, is the basis of the apprehension of *a thing*: for had it not *Being*, it were not *a thing*; and were it not *a thing*, it could not be said to be *a long thing* or *a sharp thing*; nor indeed that it were *long* or *sharp*: for to be *so*, doth include *Being*; and *what hath Being*, is *a Thing*. And thus we may observe, how the bulke of our apprehensions is composed of something adventitious, and of something formerly within us, which is of a very different nature from all the others; and yet so fitted and necessary to them, that none of them can be without it, although it not onely can be, but is best conceived without relation to any of them.

We shall easily discern, of how different a straine this conception of *Being*, is from all others, that enter by our senses, (as from

5.

The apprehension of a *thing* is in next degree to that of *Being*, and it is the Basis of all the subsequent ones.

6.

The apprehension of things knowne to us by our senses, doth consist in certaine respects betwixt two things.

the conceptions of colours, of sounds, and the like) if wee but reflect upon that act in us, which maketh it; and then compare it with the others: for we shall find, that all they do consist *in*, or of certain respects betwixt two things; whereas this of *Being*, is an absolute and simple conception of it self, without any relation to ought it else; and cannot be described or expressed with other words, or by comparing it to any other thing: only wee are sure; we understand and know what it is.

But to make this point the clearer, it will not be amisse, to shew more particularly, wherein the other sorts of apprehensions are different from this of *Being*; and how they consist in certaine respects between different things, and are knowne only by those respects: whereas this knowne only in it self; abstracting from all other things whatsoever. An example will doe it best: when I apprehend the *whiteneffe* in the wall, I may consider how that white, is a thing which maketh such an impression upon my fantasy; and so accordingly, I know or expresse the nature of *white*, by a respect or proportion of the wall; to work upon my fantasy: In like maner, if we take a notion that ariseth out of what entreth immediately by our senses, (for by joyning such also to the notion of *Being*, we make ordinary apprehensions) we shall find the same nature: as when I consider how this white wall, is *like* to another white wall, the apprehension of *likeneffe* that I have in my mind, is nothing else, but a notion arising out of the impression, which both those walles together, do make upon my fantasy; so that, this apprehension is as the former, a certain kind of respect or proportion of the two walles to my imagination: not as they make their impressions immediately upon it, but as another notion ariseth, out of comparing the severall impressions, which those two white walles made in it.

7.
Respect or relation hath not really any formall being, but only in the apprehension of man.

Let us proceed a little further, and examine what kind of thing that is, which we call *respect* or *proportion*, and where it resideth. We shall find, that there is a very great difference, between what it is in it selfe, or in its owne essence, and what it is in the things that are respective: for in them, it is nothing else but the things, being plainly and bluntly what they are really in themselves: as for example, two white walls to be like, is in them nothing else, but each of them to be white: and two quantities to be halfe and whole, is in them nothing else, but each quantity to be just what it is.

But

But a *respect* in its owne nature, is a kind of tye, comparison, tending, or order, of one of those things to another; and is no where to be found in its formall subsistence, but in the apprehension of man: and therefore it cannot be described by any similitude, nor be expressed by any means, but (like *Being*) by the sound of a word, which we are agreed upon to stirre up in us such a notion; for in the things, it is not such a thing as our notion of it is: (which notion is that, which we use to expresse by Propositions and conjunctions, and which Aristotle and Logicians expresse in common; by the word *res*, or *ad*) and therefore there is nothing out of us, to paint it by: as I could doe *white* or *square*, or *round*, or the like; because these have a being in the things that are white, or square, &c. and consequently they may be expressed by others of the like nature: but the *likenesse* that one white hath to another, or the *respect* that either of them hath to mans imagination, is only in Man; who by comparing them, giveth birth to the nature and Being of *respect*:

Out of this discourse, we may collect two singularities of man; which will much import us, to take particular notice of: the one is, that *Being* or a *thing*. (the formall notion of which is meerly *Being*) is the proper affection of man; for every particular thing is in him, by being (as I may say) grafted upon the stocke of *Existence* or of *Being*: and accordingly we see, that whatsoever we speak of, we say it is *something*: and whatsoever wee conceive, we give it the nature of a *thing*; as when we have said, the wall is white, we frame *whitenesse* as a *thing*: so did we immediately before speaking of *Respect*, we took *respect* as it were a *thing* and enquired, *where* it is: so that it is evident, that all the negotiation of our understanding, tradeth in all that is apprehended by it, as if they were *things*.

The other singularity we may observe in man is, that he is a *comparing power*; for all his particular knowledges, are nothing else but *respects* or *comparisons* betweene particular things: as for example, for a man to know heat, or cold, &c. is to know, what effects fire or water, &c. can worke upon such or such bodies.

Out of the first of these proprieties it followeth, that what affecteth a man, or maketh impression upon his understanding; doth not thereby loose its owne peculiar nature, nor is it modified to the recipient; the contrary of which, wee see happeneth perpetually

8.

That *Existence* or *being* is the proper affection of man: and that mans soule is a comparing power.

9.

A thing by coming into the understanding of man, looeth nothing of its owne peculiar nature.

petually in bodies : observe the sustenance we take ; which that it may be once part of our body, is first changed into a substance like our body, and ceaseth being what it was : when water or any liquid body is received into a vessell, it looseth its owne figure ; and putteth on the figure of the vessell it is in : if heat entreth into a body that is already hot, that heat becommeth thereby more heat ; if into a cold body, it is converted into warmth : & in like manner, all other corporeall things are accommodated to the qualities of the recipient ; and in it, they loose their owne proper termes and consistences : but what commeth into the understanding of a man, is in such sort received by him or joyned to him, that it still retaineth its own proper limitations and particular nature ; notwithstanding the assumption of it unto him : for *Being* is joyned to every thing there ; since (as we have said) it is by *Being* that any thing commeth thither : and consequently this stock of *Being*, maketh every graft that is inoculated into it, *Be* what of its own nature it is ; for *Being* joyned to another notion, doth not change that notion, but maketh it be what it was before ; sithence if it should be changed, *Being* were not added to it : as for example, adde *Being* to the notion of *knife*, and it maketh a *knife*, or that notion, to *Be* a *knife* : and if after the addition, it doth not remaine a *knife* it was not *Being*, that was added to a *knife*.

10.

A multitude of things may be united in mans understanding without being mingled or contounded together.

Out of the later of the singularities proper to man, it followeth, that multitude of things may be united in him, without suffering any confusion among themselves ; but every one of them, will remaine with its proprieties, and distinct limitations : for so of necessity it must be, when that which uniteth them to him, is the comparing of them to something besides themselves : which work could not be performed, unlesse what is to be compared, doe retain exactly its owne nature, whereby the comparison may be made : no more then one can weigh two quantities one against another, unlesse he keep asunder what is in each scale, and keep all other weights from mingling with them : and accordingly we see that we cannot compare black to white, or a horse to an oxe, unlesse we take together, the properties by which black differeth from white, or an oxe from a horse : and consequently, they must remaine unmingled and without confusion, precisely what in themselves they are, and be different in the sight of the comparer.

But

But indeed, if we look well into the matter, we shall find, that setting aside the notion of *Existence* or of *Being*, all our other notions are nothing else, but *comparisons* and *respects*: and that by the mediation of *respects*, the natures of all things are in us: and that by the varying of them, we multiply our notions: which in their first division, that reduceth their severall kinds into generall heads, doe increase into the ten famous tribes, that Logicians call *Predicaments*: and they doe comprehend under them, all the particular notions that man hath, or can have, according to the course of knowledge in this life. Of which *Predicaments* the seven last are so manifestly respective, that all men acknowledge them to be so. *Substance* we have already shewed to have a respect unto *Being*, *Quantity* we proved in the first Chapter of the former Treatise of the nature and of the operation of Bodies, to consist in a respect unto parts. *Quality* is divided into foure branches: whereof *Power* is clearly a respect to that over which it hath power, or from which it may suffer. *Habite* is a respect to the substance wherein it is; as being the property by which it is well or ill, conveniently or inconveniently affected, in regard of its owne nature; as you may observe in health, or sicknesse, or the like. The *passible Qualities* are those which we have explicated, in discoursing of the Elements and of Mixts; and whose natures we have there shewed do consist in respects of acting or of suffering. *Figure or Shape* (which is the last branch of the division of the *Predicament of Quality*) is nothing else, but a certain disposition of one part of a body to another. And so you see, how all the ten *Predicaments* doe consist purely in diversity of *Respects*: and by consequence, all our conceits and notions (excepting that of *Being*, which is the stock, upon which all the rest are grafted) are nothing else, but various respects; since all of them whatsoever, are comprised under those generall heads. Concerning which, wee shall not need to dilate our selves any further; seeing they are to be found in *Aristotle*, and in his Commentators, largely discoursed of.

In the next place, let us observe, how our understanding be-
 haveth it selfe, in considering and in apprehending these respects.
 We have already declared, that the variety of our notions, doth arise out of the respects which diverse things have to one another: hence will follow, that of the same thing, wee may have various notions

II.
 Of abstracted
 and concrete
 termes.

notions: for comparing it to different things, we shall meet with different respects between them; and consequently, we shall consider the same thing, under different notions: as when we consider an apple, under the notions of greenness, of sweetness, of roundness: of mellowness, &c. in such sort, as we have amply declared in the first Treatise, and therefore need not here enlarge our selves any further upon this particular. Now these notions are so absolutely severed one from another, and every one of them hath such a compleatness within it selfe, that we may use any one of them, without meddling at all with any of the others. And this we doe two severall wayes: the one, when our manner of apprehension determineth us to one precise notion, which is so summed up within it selfe, as it not onely abstracteth from all other notions, but also quite excludeth them, and admitteth no society with them. The other way is, when we consider a thing under a determinate notion, yet we doe it in such a manner, that although we abstract from all other notions, nevertheless we doe so, rather by neglecting than by excluding them: and even in the manner of our expression of it, we insinuate that there are other notions (without specifying what) belonging unto it.

Of the first kind of notions, are whitenesse, weight, heat, and such like, (whose names are called *abstracted termes*) which although they arise out of our comparing of the things that are white, heavy, hot, &c. to our fantasie, or to other things; yet these notions are so precise, and shut up within themselves, that they absolutely exclude all others, (as of long, short, square, rough, sharp, or whatsoever else) which may in the things accompany the whitenesse, weight, heat, &c. that our consideration is then busied only withall. Of the second kind of abstracted notions, are white, heavy, hot, &c. (whose names, expressing them, are called *concrete termes*;) which although they cause in us no other apprehensions then of whitenesse, of weight, of heat, &c. yet they are not so rigorously paled in, as the others are, from admitting society with any besides; but doe imply tacitely, that the thing which is white, heavy, hot, &c. hath besides that, some other consideration belonging unto it (whatsoever it be) which is not expressed.

Now in this later abstraction, it happeneth sometimes, that the

the notion expressed, hath but an accidentall connexion with the other notions, that are in the thing unexpressed: as for example; it is merely accidentall to the white wall as it is *white*, to be high or low, of stone, of plaster, or the like. But otherwhiles, the expressed notion is so essentiall to the concealed ones, that they cannot be without it: as when we apprehend a cloven foot, although this apprehension doe abstract from all other notions besides *clovenfootednesse* (if so I may say) yet, (as above we have declared) it is in such a manner, that it implyeth other considerations, not yet expressed, in that cloven foot: among which, some may be of that nature, that they cannot have a Being without presupposing clovenfootednesse; but others may be merely accidentall to that notion: as (for instance sake) let one be, *that the foot is cloven into three parts*; and let another be, *that it is black or hairie*; of these, this later notion of *black or hairie*, is of the first kind of abstractions, which we said had but an accidentall connexion with that which comprehended them without expressing them: for other things besides the cloven foot, may be black or hairie; in such sort as height or lownesse, to be of stone or of plaster, may belong unto other structures besides the white wall: but to be *clovenfooted into three parts*, doth so necessarily depend of being clovenfooted in generall, (which implyeth this particular) and so directly includeth it, as it cannot subsist without *clovenfootednesse*: for though we may conceive a foot to be cloven, without determining in our apprehension, into how many toes it is cloven; yet we cannot conceive it to have three, foure, or five toes, without apprehending it to be cloven: so that in such like apprehensions, the notion which is expressed, is so essentiall to the notion that is concealed and added unto it, as the concealed one cannot be conceived without the expressed one; and whensoever it is mentioned, the other is necessarily also brought in, and affirmed with it.

Now, some of these later kinds of notions, (in which what is expressed is essentiall to what is concealed) may be of such a nature as to be capable of receiving the addition of sundry other notions, so repugnant unto one another, that they cannot agree together in one subject; & yet that generall notion, without determining any of the others, be indifferent to the contrary additions that include it, and belong as much to any one, as to any other of them: and

12.
Of universall
notions.

so consequently, whatsoever may be affirmed, and is true, of the primary notion, may as well be affirmed, and is as true, of the severall particulars, arising out of the repugnant additions. Such a notion, Logicians terme an *Univrsall* one: that is, one that reacheth indifferently and equally to all the particulars comprised under it. As for example: to the notion of a living creature, may be added the notions of *Reasonable* and *unreasonable*: which first notion, when it is barely expressed, it determineth no one of the two secondary notions, more then it doth the other: but is alike indifferent to either; and whatsoever belongeth to a living creature, belongeth entirely both to a man and to a beast: yet no one thing, can be both *reasonable* and *unreasonable*. In like manner when I say, *a man is a discursive creature*; under this word *man*; there lyeth a notion, by which may be signified any particular man, as *Thomas, Iohn, William, &c.* though of it selfe, it determine no one man whatsoever: and consequently, every one of these particular men, must be allowed to be a discursive creature, because the being such, belongeth unto the notion of *man*, and that notion unto all the particulars of *Thomas, Iohn, William, &c.* and yet no particular man can be both *Thomas* and *Iohn*, or *Iohn* and *William, &c.*

In this kind of notion, we may observe yet one propriety more: which is, that of it selfe, and in its common terme, it doth not cause ones thought to range unto severall objects; nor doth it imply that there are many particulars comprised under it: yet if there be never so many, that conceit will fit them every one; and if there be but one, still it will be no lesse accommodated to that one. As for example: He that maketh a right apprehension of a *sunne*, doth not by that conception determine, whether there be many suns or but one: and if every one of the stars (which we call fixed) be suns to other earths, it fitteth them all; and if there be no other sunne, then that which shineth to us, it is satisfied and taken up with that: so likewise, before the production of *Eve*, the notion of a *man* was as fully taken up by *Adam* alone, as it is now by his numerous progenie that filleth the world: nor doth our understanding, when that terme is pronounced, consider (out of the force of the terme) whether there be many men, or onely one.

Another propriety in mans apprehension not much unlike

13.

Of apprehending a multitude under one notion.

to this, is, that he is able to comprise a multitude in one indivisible notion; and yet, that notion expresse the multiplicity of what it containeth: as we see in numbers, where the indivisible conception of *ten*, *a hundred*, *a thousand*, &c. doth plainly expresse the subject to be many; and yet that notion of the number bindeth them up (as I may say) into one bundle, that in it selfe admitteth no division, nor will permit that the least part be taken from it; for if it be, the whole bundle is destroyed and vanisheth: as when I take *ten*, if one be diminished from it, it is no longer *ten*, but *nine*. It fareth in like manner with the conceptions we frame of *All*, and *Every one*, as it doth with numbers; for if but one be deficient, it is but a part, and not *all*, or *every one*: so that these notions doe invisibly terminate a multitude. And like to this notion, is the name or terme *whole*, in respect of things which as yet have not division, but are capable of being divided; for it is so rigorous, that if the least atome or thought be wanting, it is no longer the *whole*, but onely a part.

And this is as much as at present appeareth unto me needfull to be said, concerning single apprehensions: unlesse I be permitted to adde for a conclusion, this little note, (which peradventure might have been properly set downe in another place, where we discoursed of *Being*, but that it occurred not then to me) that apprehension being rooted in the nature of *Being*, the power of it spreadeth it selfe as farre as the extent of *Being*: and consequently reacheth to all things whatsoever; for whatsoever is a *thing*, hath *Being*; and that unto which *Being* doth not reach, is nothing. Nay, it is not limited there, but graspeth even at *nothing*, and aymeth to make a notion of it, and planteth its generation, by multiplying it selfe by negations of whatsoever is. Hence we have the notions of deafnesse, of dumbnesse, of blindness, of lamenesse, of baldnesse, of death, of sinne, and of all evils whatsoever, by the want of such goods, as are sensible unto us.

I 4.

The power of the understanding reacheth as far as the extent of *being*.

T H E

THE SECOND CHAPTER.

Of Thinking and Knowing.

I.
How a judgement is made by the understanding.

HAVING thus declared the nature of single apprehensions, the method we have prescribed our selves, requireth that we examine in the next place, what effect the joyning of them together may have; for from thence doe spring *Enunciations* or *Judgements*; which are in the next rank after simple apprehensions, and are the materials whereof *discourses* are immediately framed: as when of the two apprehensions of *knife* and of *sharpe*, we may make this enunciation, *the knife is sharpe*. In this enquiry the first thing that occurreth unto us, is to consider, in what manner two differing simple apprehensions, doe become joyned to one another: and we shall find, that they are not tyed together like severall distinct things in one bundle, or like stones in a heap, where all that are comprised under one multitude, are yet circumscribed within their owne limits, and thereby are wholly distinguished from each other; but that they are as it were grafted upon one stock; which being common to both; giveth the same life to both; and so becoming one with each of them, maketh them be one and the same thing between themselves. And this is the notion of *Being* or *Existence*, in the subject we speak of: which (as we have already shewed) is the Basis and foundation of all other apprehensions; and by being common and indifferent to all, is the fittest glew to unite those that are capable of such conjunction: and accordingly we see, that most of our speech runneth upon this straine, that *this is that*, or *doth that*, (which is as much to say as *is doing that*) that *Socrates is a man*, or that *Socrates runneth*, (which signifyeth, *is running*) and the like: and since our speech proceedeth from the conceptions of our mind; it is cleare, that as the words which expresse *Being* or *Existence*, doe joyne together the other words that we use, (or at least, the greatest part of them) so likewise in our mind the apprehension of *Being*, is the glew that joyneth our apprehensions corresponding to our words.

All which will appeare to be said with great reason, if we reflect upon it; for when diverse apprehensions may be thus joyned together, it is indeed, that one and the same thing affecting us severall

verall wayes and under different considerations; those indifferent expressions doe beget different apprehensions in us: and so, till we examine the matter, every one of them seemeth to be a different thing: but when we trace these streames up to the fountaine head, we discern that all of them doe belong to one and the same thing; and that by being in that thing, they are among themselves the very same thing, however they affect us variously; and therefore may truly be said to be one, as indeed they are: and consequently, nothing is more fit to joyne together in our mind those different apprehensions, then the apprehension of *Being*; which maketh us apprehend as one thing, those notions which really, and in the thing it selfe, are but one, as we have often touched, both in the former Treatise, and lately in this: for this is the way to joyne things in the mind intelligently, and according to the proper nature of the mind; which receiving impressions from things existent, ought to consider those impressions as they flow from the very things, and not as they are in the mind it selfe; and by mediation of those impressions, must take a survey of the things themselves; and not stay at the intellectuall impressions they make in her: and consequently, must apprehend those things to be one in themselves, (although in us they be not so) according to the course of our originall and legitimate apprehensions of things; which is, as they are existent; that is, as they are in their owne nature, and in themselves; and not according to the discourses and secondary apprehensions we make of the images we find of them in our mind. And thus things are rightly joyned by apprehension; without caution in which particular, we shall run into great errors in our discourse: for if we be not very carefull herein, we are apt to mistake the use of the impressions we receive from things, and to ground our judgements concerning them, according to what we find of them in our mind, and not according to what they are in themselves: which two severall considerations, have quite different faces; although (it is true) those impressions are made by the things, and are the onely meanes by which we may rightly judge of them: provided, that we consider them as they are in the things, and not as they are in us.

Now this conjunction of apprehensions, by the mediation and the glew of *Being*, is the most naturall and fitting, not onely in regard.

regard of the things, but even in regard of us : for (as we have already shewed) it is of all others the most common and universall, the most simple or uncomposed, and the most naturall and deepest rooted in man : out of all which, it is evident, that this union of apprehensions by the meanes of *Being*, is in truth an Identification of them : for Unity being a negation of multiplicity, it followeth, that what is one, is the same : and this identification is truly and naturally expressed by saying, that *the one is the other.*

3.
How the notions of a substantive and an adjective, are united in the soule, by the common stock of being.

But insifting a little further upon this consideration, how different apprehensions become joynd and united together, by the notion of *Being* ; we may observe that this happeneth, not onely to two single ones, but to more ; according as more then two, may belong unto one thing : and it may so fall out, that more then one, be on either side the common ligament. Thus when we say, *A Man is a discursive creature ; or a Rationall soule, is an immortall substance*, the two apprehensions, of *discursive*, and of *creature*, are joynd together in a third of *Man*, by the tye of one *Being* : and the two apprehensions of *Immortall*, and of *Substance*, are united to the two others of *Rationall* and of *Soule*, likewise by the ligament of one single *Being*. Evident it is then, that the extremes are united by one *Being* : but how the two apprehensions that are ranked together on the same side of the ligament (as in our former examples, the apprehensions of *discursive* and of *creature*, of *Rationall* and of *Soule*, of *Immortall* and of *Substance*) are betweens themselves joynd to one another, is not so easie to expresse. It is cleere, that it is not done by meere conglobation ; for we may observe, that they doe belong, or are apprehended to belong, unto the same thing ; and the very words that expresse them, doe intimate so much, by one of them being an adjective ; which sheweth, they are not two things ; for if they were, they would require two substantives to describe them : and consequently it followeth that one of them must needs appertaine to the other : and so both of them make but one thing.

And there is no doubt, but in the inward apprehension, there is a variety correspondent to the variety of words which expresse it ; since all variety of words that is made by intention, resulteth out of some such variety of apprehensions. Therefore, since the words doe import, that the things have a dependance the one of the

the other, we cannot doubt, but that our apprehensions have so too: which will be conceived best, by looking into the act of our mind; when it frameth such variety of apprehensions belonging to one thing, correspondent to the variety in words of an *adjective* glewed unto his *substantive*; and attending heedfully to what we meane, when we speak so. The Hebrewes doe expresse this union, or comprising of two different apprehensions under one nation, by putting in the genitive case, the word which expresseth one of them, (much like the rule in *Lillies Grammar*, that when two substantives come together, if they belong to the same thing, the one is put in the genitive case.) As when in the Scripture we meet with these words, *the judge of unjustice, the spence of wickednesse, the man of sinne, or of death*; which in our phrase of speaking, doe signify an unjust judge, a wicked spence, and a sinfull or dead man. In which it is evident, that as well the manner of understanding, as of speaking, taketh each paire of these notions to belong unto one thing; that is, to have both of them, one and the same *Existence*, although there intervene not the formal expression of their being one. Thus we see, how one *Being* serveth two different wayes to joyne and unite severall apprehensions: and if we will examine all the negotiations of our understanding, we shall hardly find any notions so farre distant, but may be brought together, either by the one of these wayes, or by the other.

But this composition and joyning of severall apprehensions by the glew of *Being*, is not sufficient to make us deem a thing to be really such, as their union painteth in the mind, or as the words so tyed together doe expresse in speech. Well may it cause us to think of the thing; but to think, or to deem it such an one (which word of *deeming*, we shall bee obliged henceforward to use frequently, because the word *thinking* is subject to equivocation) requireth the addition of something more, then barely this composition of apprehensions; which unlesse they be kept straight by some levell, may as well swarve from the subject, as make a true picture of it. Here then we are to examine, what it is that maketh us thinke any thing to be, such as wee apprehend it: this wee are sure of, that when we doe so, our actions which proceed upon reason, and which have relation to that thing, are governed and steered in every circumstance, just as the thing were truly so:

4.
That a feiled judgement becometh a part of our soule.

as for example, if a man doe really deem the weather to be cold, or that his body is distempered, he putteth on warmer cloathes, or taketh physick; although peradventure he is mistaken in both: for his deeming them to be so, maketh him demean himselfe in such sort, as if really they were so. It is then evident, that by such thinking or deeming, the nature conceived, is made an active principle in us: unto which if we adde, that all the knowledge we have of our soule, is no more, but that it is an *active force* in us, it seemeth, that a thing, by having apprehensions made of it in our mind, and by being really thought to be agreeable to such apprehensions, becometh (as it were) a part or affection of our soule, and one thing with it. And this peradventure is the cause; why an understanding man cannot easily leave an opinion once deeply rooted in him; but doth wrestle and strive against all arguments that would force him from it, as if a part of his soule or understanding were to be torne from him: in such manner as a beast will cry and struggle to save his body, from having any of his limbes disjoynted or pulled in peices.

5.
How the soule
commeth to
deem or settle
a judgement.

But this observing the effect which followeth of our deeming a thing to be thus or so, is not sufficient to informe us, what it is that causeth that deeming. We must therefore take the matter a little higher, and look into its immediate principles: and there we shall find, that it is the knowing of what we say to be true, and the assurance, that the things are as wee deem them, which quieteth our soule, and maketh it consent unto them, and proceed to action upon that consent. Now this knowledge, is the most eminent part of deeming; and of all our acquisitions, is the most inseparable from us: and indeed in rigour, it is absolutely inseparable by direct meanes; however peradventure by indirect meanes it may be separated.

Let us then consider how wee attaine unto it; and how sometimes wee faile in the purchase of it; and what degrees of assurance or of probability there are between it and error. To this intent, wee may observe that the greatest assurance, and the most eminent knowledge wee can have of any thing, is of such Propositions, as in the Schooles are called *Identicall*; as if one should say, *Iohn is Iohn*, or *a man is a man*: for the truth of these Propositions is so evident and cleare, as it is impossible any man should doubt of them, if hee understand what he

hee saith : and if wee should meet with one that were not satisfied of the verity of them, wee would not goe about to prove them to him, but would onely apply our selves to make him reflect upon the words hee speaketh, without using any further industry to gaine his assent thereunto : which is a manifest signe, that in such Propositions, the apprehending or understanding them, is the same thing as to know them and to consent unto them : or at the least, that they are so necessarily conjoynd, as the one followeth immediately out of the other, without needing any other causes to promote this effect, more then that a man be disposed, and willing to see the truth : so as wee may conclude, that to understand a Proposition which onely carrieth its evidence with it, is to know it. And by the same reason, although the evidence of a Proposition, should not at the first sight bee presently obvious unto us, yet with unfolding and explicating of it, wee come at length to discern it ; then likewise the apprehending of it, is the knowing of it.

We must therefore enquire, what it is that causeth this evidence : and to that purpose, reflecting upon those instances wee have given of *Identicall Propositions*, we may in them observe, that evidence ariseth out of the plaine Identification of the extreames that are affirmed of one another; so that, in what Proposition soever, the Identification of the extreames is plaine, the truth of it is evident unto us, and our mind is satisfied and at quiet; as being assured that it knoweth it to be so as the words say it. Now all affirmative Propositions doe by the forme of them import an Identification of their extreames, (for they all agree in saying *This is that*) yet they are not all alike in the evidence of their Identification : for in some it sheweth it selfe plainly, without needing any further help to discover it; and those are without any more adoe knowne of themselves, as such *Identicall sayings*, wee even now gave for examples : others require a journey somewhat further about to shew their Identification ; which if it be not so hidden, but that it may in the end bee discovered and brought to light, as soon as that is done, the knowledge settled by them in the soule, is certaine and satisfactory as well as the other : but if it be so obscure, that we cannot display the Identification of it, then our mind suspendeth his assent, and is

unquiet about it, and doubteth of the truth of it : in some Propositions, whiles he searcheth and enquireth after the Identification of their extreames; peradventure he discerneth, that it is impossible there should be any between them; and then on the other side, he is satisfied of the falsity of them : for if a Proposition be affirmative, it must necessarily be a false one, if there bee no Identification between the extreames of it.

By this discourse, wee have found two sorts of Propositions, which beget knowledge in us. The one, where the Identification of the extreames, is of it selfe so manifest, that when they are but explicated, it needeth no further prooffe. The other, where though in truth they be Identified, yet the Identification appeareth not so cleare, but that some discourse is required to satisfy the understanding therein. Of the first kind, are such Propositions as doe make one of the extreames the definition of the other whereof it is affirmed : as when wee say, *a man is a reasonable creature*; which is so evident, if we understand what is meant by a *Man*, and what by a *reasonable creature*, as it needeth no further prooffe to make us know it : and knowledge is begotten in us, not only by a perfect Identification of the extreames, but as well by an imperfect one : as when what is said of another, is but part of its definition; for example, if one should say, *a man is a creature*, no body that knoweth him to be a ratioll creature, (which is his compleat definition) could doubt of his being a creature; because that the being a *creature*, is partly identified to being a *ratioll creature*. In like manner, this obvious evidence of Identification, appeareth as well where a compleat division of a thing is affirmed of the other extreme, as where that affirmation is made by the totall or partiall definition of it : as when we say, *number is even or odde*: an enuntiation is true or false, and the like : where, because what is said, compriseth the differences of the thing whereof it is said, it is plaine that of them must needs bee that whereof wee speak.

Peradventure some may expect, that we should give *Identicall Propositions* (among others) for examples of this plaine evidence: but because they bring no acquisition of new knowledge unto the soule, (the doing of which, and the reflecting upon the manner, is the scope of this Chapter) I let them passe without

out any further mention, upon this occasion having produced them once before, onely to shew by an undeniable example, what it is that maketh our soule consent unto an enunciation, and how knowledge is begotten in her, that we might afterwards apply the force of it to other Propositions.

Let us therefore proceed to the second sort of Propositions, which require some discourse, to prove the Identification of their extreames. Now the scope of such discourse is, by comparing them unto some other third thing, to shew their Identification between themselves; for it sheweth, that each of them apart is identified with that new subject it bringeth in: and then our understanding is satisfied of their identity, and our soule is secure of that knowledge it thus acquireth, as well as it is of that which resulteth out of those Propositions, which beare their evidence in their first aspect.

This negotiation of the understanding to discover the truth of Propositions, when it is somewhat hidden, (which we call *discourse*) as it is one of the chiefest and noblest actions of the soule, so doth it challenge a very heedfull inspection into it: and therefore we will allow it a peculiar Chapter by it selfe, to explicate the nature and particularities of it. But this little wee now have said concerning it, is sufficient for this place; where all we ayme at is to prove (and I conceive we have done it very fully) that when *Identity* between two or more things, presenteth it selfe to our understanding, it maketh and forceth knowledge in our soule.

Whence it is manifest, that the same power or soule, which in a single apprehension is possessed with the *Entity* or *Vnity* of it, is that very power or soul, which applyed to an *Enunciation*, knoweth or deemeth; since *knowing* is nothing else, but the apprehending of manifest Identity in the extremes of a Proposition, or an effect immediately consequent out of it, in the soule that applyeth it selfe to apprehend that Identity. Which apprehension is made, either by the force of the extremes, applyed immediately to one another, or else by the application of them to some other thing: which peradventure may require yet a further application unto new apprehensions, to make the Identity between the first extremes appeare evidently.

Now, as when *Identity* truly appeareth, it maketh evidence to our understanding, and begetteth assured knowledge in our soule;

6.
How opinion is
begotten in
the understand-
ing.

fole; so, when there is onely an apparent Identity, but not a reall one, it happeneth that the understanding is quieted without evidence; and our soule is fraught with a wrong or slight beliefe, instead of certaine knowledge: As for example, it is for the most part true, that what wise men affirme, is so as they say; but because wise men are but men (and consequently not infallible) it may happen that in some one thing, the wisest men that are may misse, though in most and generally speaking, they hit right. Now if any body in a particular occasion, should (without examining the matter) take this proposition rigorously and peremptorily, *that what wise men affirme is true*; and should thereupon subsume with evidence, *that wise men say such a particular thing*, and should thereupon proceed to beleve it; in this case he may be deceived, because the first proposition is not verily, but onely seemingly evident.

And this is the manner how that kind of deeming, which is either opposed, or inferiour to knowledge, is bred in us: to wit, when either through temerity, in such cases where we may, and it is just we should examine all particulars so carefully, that no equivocation or mistake in any part of them, be admitted to passe upon us for a truth, and yet we doe not: or else, through the limitednesse and imperfection of our nature, when the minutenesse and variety of petty circumstances in a businesse is such, as we cannot enter into an exact examination of all that belongeth to that matter, (for if we should exactly discusse every slight particular, we should never get through any thing of moment) we settle our understanding upon grounds that are not sufficient to move and determine it. Now in some of these cases, (and particularly in the latter) it may happen, that the understanding it self is aware, that it neither hath discovered, nor can discover evidence enough, to settle its assent with absolute assurance: and then it judgeth the beliefe it affordeth unto such a proposition, to be but probable; and instead of knowledge, hath but *opinion* concerning it. Which *opinion* appeareth to it more or lesse probable, according as the motives it relyeth on, are stronger or weaker.

There remaineth yet another kind of deeming for us to speake of; which though it ever faile of evidence, yet sometimes it is better then opinion, for sometimes it bringeth certitude with it. This we call *Faith*; and it is bred in this sort: when we meet with

7.
How faith is
begotten in the
understanding.

with a man, who knoweth something which we doe not, if with-
all we be perswaded that he doth not, nor will not tell a lye; we
then beleewe what he saith of that thing to be true: now accord-
ing to the perswasion we have of his knowledge and veracity,
our beliefe is strong, or mingled with doubt: so that if we have
absolute assurance and certainty, that he knoweth the truth and
will not lye, then we may be assured, that the faith which wee
yeeld to what he saith, is certaine as well as evident knowledge
is certaine, and admitteth no comparison with opinion, be it never
so probable: but so it may happen, that we may be certainly as-
sured that a man doth know the truth of what he speaketh of, and
that he will not lye in reporting it to us: for seeing no man is
wicked without a cause; and that to tell a lye in a serious matter,
is a great wickednesse; if once we come to be certaine that he
hath no cause, (as it may fall out we may) then it followeth, that
we are assured of the thing which he reporteth to us.

Yet still such faith falleth short of the evidence of knowledge
in this regard, that its evidence sticketh one degree on this side the
thing it selfe: and at the push, in such a case we see but with ano-
thers eyes; and consequently, if any opposition doe arise against
our thought thereabout, it is not the beames, and the light of the
thing it selfe, which strengthen us against such opposition, but the
goodnesse of the party upon whom we rely.

Before I goe any further, I must needs remember one thing,
that our Masters teach us: which is, that truth and falsehood are
first found in sayings or *Enunniations*; and that although single
apprehensions are in our mind before these judgements, yet are
they not true or false themselves, nor is the understanding so by
them. To comprehend the reason of this maxime, let us consider
what truth and falsehood are: surely truth is nothing else, but the
confirmity of our understanding, with the things that make im-
pression upon it: and consequently, falsehood is a disagreeing
between our mind and those things: if the existence which the
things have in us, be agreeable to the Existence they have in
themselves; then our understanding is true; otherwise it is false.
Now the naturall perfection of our Soule or understanding, is to
be fraught with the rest of the whole world, that is to have the
knowledge of all things that are; the knowledge of their essen-
ces, of their natures, of their proprieties, of their operations, and

8.

Why truth is
the perfection
of a reasonable
soule: and why
it is not found
in simple ap-
prehensions as
well as in E-
nunniations.

of whatsoever else belongeth to them all in general, and to every one of them in particular : but our soule cannot be stored or fraught with any thing, by other meanes then by her assent or deeming : whereupon it followeth, that she cannot have her perfection, untill her deemings or judgements be perfect ; which is, that they be agreeable unto the things in the world : when they are so, then are they true. And this is the reason why truth is the aime and perfection of the soule. Now then, truth residing onely in the assents and judgements of the soule, (which are the traffick whereby she enricheth her selfe with the rest of the world) and they peing framed by her discerning an identity betweene two things ; which she expresseth by affirming one of them of the other : it followeth, that nothing can be true or false, but where there is a composition of two extremes, made by the ones being affirmed of the other ; which is done onely in Enuntiations or judgements : whiles single apprehensions assent to nothing, and therefore settle no knowledge in the soule ; and consequently are not capable of verity or falsity, but are like pictures made at fanfie, some one of which may happen to be like some Person, but cannot be said to be the picture of him, because it was not drawn from him : so these bare apprehensions, because there is not in the man union of the soule to the outward world, or to the Existence which actuateth its object, therefore they make not the soule to be the image of the things existent : but the judgement, which still taketh a thing existent, or as existent, in the subject of the proposition, draweth its picture from the thing it selfe : and therefore it maketh the soule to be well or ill painted, in respect of the thing that is true or false.

And this is the reason, why in one sense doubtfull propositions, which the understanding (not being yet resolved) maketh inquiringly to informe it selfe of the truth of them, cannot be said to be true or false ; for all that while, the soule yeeldeth no assent unto them, either one way or other ; yet in another sense they may, which is, taking them as subjects that the understanding determineth unto it selfe to treat of : for there being two extremes in them, and the proposition consisting in this, whether these extremes be identified or no, it followeth, that since one part must of necessity be, such a proposition spoken at randome, or written by chance without designe, is of necessity either

true or false; according as the extremes of it, are or are not one thing.

There occurreth no more unto my consideration to be said in this place, concerning the assents and judgements of the mind: unlesse it be, to explicate in a word or two, the severall qualities of them, which are found in severall Persons; and to point at the reason why they are called by those names, which they are universally knowne by. To which purpose we may observe, that judgement or *deeming*, being a quieting of the mind, it followeth that the mind must needs be at disquiet and at unrest, before it commeth to judge: so that we may conclude, that judgement or thinking, is a good attained by a former motion. Now according to the quality of this motion, the judgement or assent, is qualified and denominated. Wee must therefore consider what belongeth to motion; which when wee have done, wee shall in judgements find something proportionable thereunto.

We know there is a beginning and an ending in motion; and that there are parts by which it is drawn out in length: all which must be particularly considered, in our comparing of motions unto judgements. Now then, as he that would know precisely the nature of any motion, must not begin his survey of it, after it hath been some time in fluxe; nor must give over his observing it, before it have arrived unto its utmost period; but ought to carry his attention along from its first origine, and passe with it through all its parts, untill it ceasing, give him leave to doe so too (for otherwise, it may happen that the course of it be differing in those parts he hath not observed, from those that he hath, and accordingly, the picture he shall make of it by that imperfect scantling, will prove an erroneous one;) so in like manner, when a man is to make a *judgement* of any matter in question, to give a good account of it, he must begin at the root, and follow successively all the branches it divideth it selfe into, and drive every one of them to their utmost extremity and period: and according as in judging he behaveth himselfe well or ill, in the severall circumstances that are proportionable to the beginning, ending, and parts of motion; so his judgement is qualified with the names of severall vertues agreeing thereunto, or of their opposite defects.

9.

What is a solid judgement, and what a slight one.

If he begin his considerations very low, and from the very bot-
tome and root of the affaire, which is from the first and all com-
prehending principles of the question, and proceed on orderly tak-
ing all before him; his judgement is accounted *deep, profound,*
and solid: for he that casteth so farre, as to leave behind him no
part of the matter he is inquiring about, & then driveth his course
steadily and smoothly forwards, without any leaps over rugged
passages, or interruptions, or loose breaches; must of necessity
make a well grounded judgement; and such an one, as cannot
easily be overthrown, or he be easily removed from it.

And this is indeed the full reason, of what a little above we on-
ly glanced at: namely, why understanding men are usually ac-
counted obstinate in their tenets, and are hard to be removed from
their opinions once settled in their minds: for when other men
oppose them, they urge nothing (for the most part) against these
judicious mens resolutions or believes, but what they have already
thoroughly foreseen: but these on the other side, doe see a great
deale, that their opposers reach not unto; so that notwithstanding
all such opposition, they continue still unshaken in their *judge-
ments*: for which, the others which see not as much as they, doe
thinke them obstinate, and not led by reason, because they fol-
low not that short reason, beyond which themselves cannot
reach.

The contrary vice to this, is called a *slight judgement*: and con-
sisteth herein, that a man out of a few, and an insufficient num-
ber of circumstances, resolveth the whole case: which temerity
and short sightednesse of judgement, is significantly taxed in our
English proverb, that *a fooles bolt is soone shot*.

Thus much for the beginning of a judgement: the next confi-
deration may be concerning the end of it; in regard whereof, if it
reach to the utmost extent and period of what is considerable in
a hard question proposed, it gaineth the title of *sharpe*, or of *sub-
tile*, and *acute*; for the hardnesse of the matter that perplexeth
ones judgement, consisteth in the involution of things, which
looked upon in grosse, doe seeme to have no distinction or oppo-
sition among themselves; and yet are in truth of very different
and contrary natures. Now a good judgment divideth and cut-
teth through them, and alloteth unto every particular thing its
proper limits and bounds: wherefore, as in corporall substan-
ces,

10.
What is an a-
cute judgment,
and what a dull
one.

ces, the vertue of dividing is sharpnesse and edge, by translation from thence, such a judgement as pierceth neatly and smartly betweene contradictories that lie close together, is called *sharpe* and *acute*. In like manner, *subtillity* is a vertue, whereby a liquor or other body searcheth every little hole and part of what it worketh upon, till it get through it; and from thence, it is used in judgements to signifie the same: whose opposite vice is called *dulnesse*.

In the last place we are to examine, what proportion a judgement holdeth with the parts of motion: in these, two things are to be considered, namely the quantity or multitude of those parts, and the order of them. As for the quantity in a motion, it belongeth either to long or short, or to quick and slow: now, where the beginning and ending are already knowne and determined, and consequently where the length is determined, and dependeth not at all of the judge to alter it, (for he must take it as the matter giveth it) there a judgement can acquire no denomination of perfection or deficiency, from length or from shortnesse; for they belong originally to the matter of the judgement; and the judgement must accordingly fit it selfe to that; and therefore is liable neither to commendations nor to reproach, for being long or short: it remaineth then, that the vertue in *judging* answerable to the quantity of motion, must consist in quicknes and celerity; and the contrary vice, in slownesse and heavinesse.

As for order in the severall parts of motion, wee know that if they be well ordered, they are distinct and easily discernable. Which vertue, in our subject, is called *clearnesse of judgement*; as the contrary vice is *confusion*.

II.

In what consisteth quicknesse and clearnesse of judgement; and their opposite vices.

T H E

THE THIRD CHAPTER.

Of Discoursing.

1.
How discourse
made.

IN the last Chapter we have shewed, how two apprehensions joyned together doe make a judgement: now in this our first employment will bee, to shew how three of these thoughts or judgements, well chosen and duely ordered, doe compose the first and most simple of perfect discourses; which Logicians call a Syllogisme: whose end and effect is to gaine the knowledge of something, before hidden and unknowne. The meanes whereby this is compassed, is thus. By the two first judgements, we joyn the extremes of the proposition we desire to know, unto some third thing; and then, by seeing that they both are one third thing, and that one can be but one, we come to discern, that truly one of them is the other; which before we saw not: so that, the *identity*, which first made an identicall proposition be knowne and agreed unto, and afterwards caused the like assent to be yeelded unto those maximes, whose identification presently shewed it selfe, now by a little circuit and bringing in of a third terme, maketh the two first (whose identification was hidden and obscure, whiles we looked upon the termes themselves) appeare to be in very truth but one thing.

2.
Of the figures
and moods of
Syllogismes.

The various mingling and disposing of these three termes in the two first propositions, begetteth a variety in the syllogismes that are composed of them: and it consisteth in this, that the assumed terme unto which the other two are interchangeably joyned, is either said of them, or they are said of it: and from hence spring three different kinds of syllogismes; for either the assumed or middle terme, is said of both the other two; or both they are said of it; or it is said of one of them, and the other is said of it: neither is there any deeper mysterie then this, in the three figures, our great Clerkes talke so much of: which being brought into rules, to help our memory in the ready use of this transposition of the termes; if we spin our thoughts upon them into over small threds, and thereof weave too intricate webs (meane while not reflecting upon the solid ground within our selves, whereon these rules are built, nor considering the true end why;) we

we may spend our time in triviall and uselesse subtilities : and at length, confound and misapply the right use of our naturall discourse, with a multitude of precepts drawne from artificiall Logick.

But to returne to our matter in hand; under this primary three-fold variety, is another of greater extent, growing out of the divers composition of the three termes, as they are qualified by *affirmation* or *negation*, and by *universality* or *particularity*: for that unity, which the two termes, whose identification is enquired after, must have by being joyned with the third, becommeth much varied by such divers application : and from hence shooteth up that multitude of kinds of syllogismes, which our Logicians call Moods. All which I have thus particularly expressed, to the end we may observe how this great variety hangeth upon the sole string of *identity*.

Now these Syllogismes, being as it were interlaced and woven one within another, (so that many of them do make a long chain, whereof each of them is a link) doe breed, or rather are all the variety of mans life : they are the steps by which we walk in all our conversations and in all our businesses : man as he is man, doth nothing else but weave such chaines : whatsoever he doth, twarving from this worke, he doth as deficient from the nature of man : and if he doe ought beyond this, by breaking out into divers sorts of exterior actions, he findeth neverthelesse in this linked sequel of simple discourses, the art, the cause, the rule, the bounds, and the modell of it.

Let us take a summary view of the vast extent of it, & in what an immense Ocean one may securely saile; by that never varying Compasse, when the needle is rightly touched, and fitted to a well moulded boxe; making still new discoveries of regions, far out of the sight and believe of them; who stand upon the hither shore. Humane operations are comprised under the two generall heads of *Knowledge* and of *Action* : if we looke but in grosse, upon what an infinity of divisions these branch themselves into, we shall become giddy, our braines will turne, our eyes will grow weary and dimme, with ayning onely at a suddaine and roving measure of the most conspicuous among them, in the way of knowledge.

We see what mighty works men have extended their labours unto;

3.

That the life of man as man, doth consist in discourse and of the vast extent of it.

unto; not onely by wild discourses, of which huge volumes are composed, but even in the rigorous method of Geometry, Arithmetick, and Algebra; in which, an *Euclide*, an *Apollonius*, an *Archimedes*, a *Diophantus*, and their followers, have reached such admirable heights, and have wound up such vast bottomes, sometimes shewing by effects, that the thing proposed must needs be as they have set downe, and cannot possibly be any otherwise; otherwhiles, appaying the understanding (which is never truly at rest, till it hath found the causes of the effects it seeth) by exposing how it commeth to be: so that the Reader calling to mind, how such a thing was taught him before, and now finding another unexpectedly convinced upon him, easily seeth that these two put together, doe make and force that third to be, whereof hee was before in admiration how it could be effected: which two wayes of discourse, are ordinarily knowne by the names of *Demonstrations*; the one called *à priori*, the other *à posteriori*.

Now if we look into the extent of the deductions out of these, we shall find no end. In the heavens, we may perceiue Astronomy measuring whatsoever we can imagine; and ordering those glorious lights, which our Creator hath hanged out for us; and shewing them their wayes, and pricking out their paths, and prescribing them (for as many ages as he pleaseth before hand) the various motions they may not swarve from in the least circumstance. Nor want there sublime soules, that tell us what metall they are made of, what figures they have, upon what pillars they are fixed, and upon what gimalls they move and performe their various perious: witnesse that excellent and admirable worke, I have so often mentioned in my former Treatise. If we look upon the earth, we shall meet with those, that will tell us how thick it is, and how much roome it taketh up: they will shew us how men and beasts are hanged unto it by the heeles; how the water and aire doe cover it; what force and power Fire hath upon them all; what working is in the depths of it; and of what composition the maine body of it is framed: where neither our eyes can reach, nor any of our senses can send its messengers to gather and bring back any relations of it. Yet are not our Masters contented with all this: the whole world of bodies is not enough to satisfye them: the knowledge of all corporeall

reall things, and of this machine of heaven and earth, with all that they enclose, cannot quench the unlimited thirst of a noble mind, once set on fire with the beauty and love of Truth.

*Astuat infelix, angusto limite mundi,
Vi Gyara clausus scopulis, parvâque seripho.*

But such heroick spirits, cast their subtile nets into another world, after the winged inhabitants of the heavens; and finde meanes to bring them also into account, and to serve them (how imperceptible soever they be to the senses) as dainties at the soules table. They enquire after a maker of the world we see, and are our selves a maine part of; and having found him, they conclude him (out of the force of contradiction) to be eternall, infinite, omnipotent, omniscient, immutable, and a thousand other admirable qualities they determine of him. They search after his tooles and instruments, wherewith he built this vast and admirable pallace, and seeke to grow acquainted with the officers and stewards, that under him governe this orderly and numerous family. They find them to be invisible creatures, exalted above us more then we can estimate, yet infinitely farther short of their and our Maker, then we are of them. If this doe occasion them to cast their thoughts upon man himselve, they find a nature in him (it is true) much inferiour to these admirable *Intelligences*, yet such an one, as they hope may one day arrive unto the likeness of them: and that even at the present, is of so noble a mould, as nothing is too big for it to faddome, nor any thing too small for it to discern.

Thus we see knowledge hath no limits; nothing escapeth the toyles of science; all that ever was, that is, or can ever be, is by them circled in: their extent is so vast, that our very thoughts and ambitions are too weak and too poore to hope for, or to ayme at what by them may be compassed. And if any man, that is not inured to raise his thoughts above the pitch of the outward objects he converseth dayly with, should suspect that what I have now said, is rather like the longing dreames of passionate lovers, whose desires feed them with impossibilities, then that it is any reall truth; or should imagine that it is but a Poetike Idea of science, that never was nor will be in act: or if any other, that hath his discoursing faculty vitiated and per-

perverted, by having been imbued in the schooles with unsound and umbratile principles, should perswade himselfe, that howsoever the pretenders unto learning and science, may talk load of all things, and make a noise with Scholastick termes, and perswade their ignorant hearers that they speak and unfold deep mysteries, yet in very truth, nothing at all can be knowne: I shall beseech them both to suspend their conjectures or beliefs herein, and to reserve their censure of me, whether or no I have strained too farre, untill the learned Author of the Dialogues of the world, have enriched it with the work he hath composed of Metaphysikes: in which, going orderly and rigorously by continued propositions, in such sort as Mathematicians demonstrate their undertakings, he hath left no scope for wrangling braines to make the least cavill against his doctrine: and casting his sharp sighted thoughts over the whole extent of nature, and driving them up to the Almighty Author of it, he hath left nothing out of the verge of those rules, and all comprehending principles he giveth of true science. And then I doubt not, but they will throughly absolve me from having used my amplification, in aiming at the reach of this allgrasping power. For my part, the best expression that I am able to make of this admirable piece, I must borrow from witty *Galileus*, when hee speaketh of *Archimedes* his long missed booke of glasses; and professes, that having some of the Elements or bookes of it entrusted in my hands by the Author, I read them over with extréam amazement, as well as delight, for the wonderfull subtilty, and solidnesse of them.

4.
Of humane
actions, and of
those that con-
cern our selves.

Thus much for knowledge. Now let us cast an eye upon humane actions. All that we doe (if we doe it as we should doe, and like men) is governed and steired by two sorts of qualities: the one of which, we call *Arts*; the other *Prudences*. An art, is a collection of generall rules, comprehending some one subject, upon which we often worke. The matters we work upon (out of which the particular subjects of arts doe spring) are of 3. kinds: our selves, our neighbours, and such dumbe or insensible things, as compose the rest of the world.

Our actions upon our selves, are the highest and the noblest of all the rest, and those by which we live and work as men: or to expresse my selfe better, they are those by which we perfect
that

that part of us, which maketh us men, and by which wee direct and leuell all wee doe, according to the rule of reason; not suffering our actions to swarve from what shée dictateth unto us. This is done, by multiplying and heightning the thoughts of these things, which maintain us in reason; whether the motives be morall, as the examples of worthy persons, and the precepts and perswasions of wise men, and the like, or whether they be naturall, as the consideration of the sweet and contented life, which vertue giveth us here, by good conversation, honour, profit, quiet, pleasure, and what else soever groweth out of so excellent a root: as also, of the beatitude and happy state it bringeth us to in the next; and of the contrary effects which spring from vice. Againe, by observing the motives and wayes of our passions and animall desires, we learn how to prevent them; how to terrify them; and how to wear them gently away by litle and litle, through sometimes giving them diversions, through otherwhiles restraining them with moderation, and through oftentimes cutting of the occasions, and abridging them of their naturall encreasings. All these things are brought into art and rule; whose lessons, were men but as carefull and industrious to study, as they are to become Masters in vaine and triviall things, they would enjoy happy lives.

In the next place, we are to consider the actions whereby we work upon our neighbours. They are chiefly *government* and *negotiation*: both which are of one kind; and have but this difference, that the one is done in common, the other is performed in particular. The means by which we command, are rewards and punishments; which who hath in his hands, may assuredly by wise using them, bring to passe whatsoever he hath a mind unto.

Upon occasion of mentioning these two powerfull motives, which have so maine an influence in mens actions, we may note by the way, that many of them, and that work most forcibly upon mens minds, are things whose subsistence we know not where to find; as honour, praise, glory, command, singularity, eminencie, shame, infamy, subjection, reproach, and the like: unto any of which, none of our senses can reach; and yet they govern mans life, in a manner wholly and perfectly.

In *negotiation*, wee propose to single men their owne interests and profits; not such as the proposer can, or will effect; but

5:
Of humane
actions as they
concerne our
neighbours.

such as are likely to arise out of the action wee endeavour to draw him unto with whom we treat. In both these, the usuall labour is, to make our neighbours willing to leave some present good, in hope of a greater to come; or to be content to undergoe some present harme, for feare of a greater to ensue. The generall instrument which they use, is *discourfing*; whose vertue consisteth partly in our owne mind, and partly in delivering our mind to others: for first we must know what we should say, and next in what manner we should say it.

6.
Of Logick.

The art which directeth our owne mind, and teacheth us what to say, is *Logicke*: whose parts are two; according as the affaires falling into discourse, are likewise of a twofold nature: the one instructeth us how to manage and order our reason, when it dealeth with such subjects as wee may attaine to certainty in. And here the rules of *Demonstration* take place; teaching us to define, to divide, and to conclude. The other instructeth us how to behave our selves, when we meet with such subjects, as a good & probable guesse is the farthest wee can reach unto towards the knowledge of them: and for these; the *Topicall* part of Logick serveth; the which, taking a view of all the accidents belonging to any thing propounded, sheweth how to draw probabilities from every one of them.

7.
Of Grammar.

Our discourfing to others, is either to open our mindes barely unto them; or to perswade them of somewhat our selves believe; or to winne them to somewhat wee would have them doe. For the bare delivery of our minds to others, we have *Grammar*; the scope of which art, consisteth first, in teach us to deliver our conceptions plainly and clearly, (which is the maine intent of speaking) next, in making, our discourse bee succinct and brieve, (which is the measure of our speaking, both for our selves and others;) and lastly, in setting our words, so as what wee say, may bee accompanied with sweetnesse; both in common, in regard of the eare, by avoyding such harsh sounds as may offend it; and in particular, in regard of the custome of the language wherein we speak, and of the persons to whom we speak.

8.
Of Rhetorick.

The art whereby we may perswade others, and winne them to assent unto what we would have them, is *Rhetoricke*. Her rules instruct us how to dispose and order with best advantage, in regard of

Of the Auditours disposition, both the reasons which *Logicke* affordeth us, and the words which *Grammar* storeth us with: as also, how to give life and motion to what we say, by our action and gesture; that so we may perswade our Auditory, such passions raigne in us, as we seek to stirre up in them: for as we may observe, that one who yawne, maketh another likewise yawne; and as our seeing others laugh, provoketh laughing also in us (the reasons whereof wee have touched in the former Treatise;) after the same manner, what passion soever we exhibite in our selves, the same stealeth insensibly upon those wee speak unto; whiles their mind attending to the words they heare, is not aware of the subtile spirits motions, that by a kind of contagion rise and swell in their hearts: according to which naturall inclination in all men, the Master of Poets and excellent observer of mens humours said passing well:

Si vis me flere, dolendum est

Primum ipsi tibi.

Hence grow those encreases by metaphors, hyperboles, and other tropes and figures: hence those fervors by interrogations, exclamations, apostrophes, and the like; which when they are fitly placed, they carry the Auditour even against his will.

Poetry, is not a governour of our Actions, but by advantagious expressing some eminent ones, it becometh an usefull directour to us; and therefore challengeth a place here. The designe of it is, by representing humane actions in a more august and admirable hew, then in themselves they usually have: to frame specious Ideas, in which the people may see, what is well done, what amisse, what should be done, and what by errour is wont to be done: and to imprint in mens minds a deep conceit of the goods and evils, that follow their vertuous or vitious comportment in their lives.

If those who assume the title of *Poets*, did ayme at this end, and would hold themselves strictly to it, they would prove as profitable instruments as any the commonwealth had: for the delightfulnesse and blithnesse of their compositions, inviteth most men to be frequently conversant with them; (either in songs, or upon the stage, or in other *Poemes*) whiles the sober aspect and severity of bare precepts, deturneth many from lending a pleased

care to their wholesome doctrine; and what men swallow with delight, is converted into punishment: so that, if their drift were to settle in mens minds a due valuation of vertue, and a detestation of vice, no art would doe it more universally, nor more effectually: and by it, mens hearts would be set on fire to the pursuit of the one, and be shrunk up with dislike and horreur against the other. But unto such a Poet as would ayme at those noble effects, no knowledge of *Morality*, nor the nature and course of humane actions and accidents must be wanting: he must be well versed in *History*; he must be acquainted with the progresse of nature, in what she bringeth to passe; he must be deficient in no part of *Logicke*, *Rhetoricke*, or *Grammar*: in a word, he must be consummate in all arts and sciences, if he will be excellent in his way.

10.
Of the power
of speaking.

But whiles we thus entertain our selves with those arts, which serve us in discoursing with others, it were a great oversight to forget that faculty, which is the *basis* and ground-work of all those: and that is, the power of speech, which nature hath bestowed upon us. It consisteth in two actions: the one outward, the other inward: the outward, is the giving of various sounds to our breath, as it passeth through our mouth, by divers conjunctions of our tongue, teeth, and lips, to themselves, or to divers parts of our mouth, or by their separations from them: in which, we see that birds are able to imitate us, and I am perswaded, the like might be effected by insensible creatures, if a dexterous man would employ his time, in contriving and making an instrument to expresse those different sounds; which, not having more then seven substantiall differences besides the vowels (as some who have carefully noted them, doe affirme) it would peradventure be no hard matter to compose such an engine.

The inward action of locution, is the framing of convenient answers to what is asked; of fit replies to what is said; and in a word, to speak appositely, and to the purpose: whereunto, neither beast nor dead instrument can be brought, unlessse the artificier be able to endue it with understanding.

11.
Of arts that
concern dumbe
and insensible
creatures.

All other arts, instruct us how to work orderly upon beasts and insensible bodies: by some of them, we cultivate living creatures, as when husband-men nourish sheep, oxen, foule, and the like, for slaughter: by others, we discipline them, as when we

teach

teach horses, dogges, apes, hawkes, parrats, and some kind of fishes, to hunt, to play, and in a word, to doe somewhat either for our profit, or for our pleasure: and again, by others we use their natures to our ends; as when wee lay baits to catch them, when when we set egges under hennes, to have the chickens, and the like: by other arts, we work as powerfully upon insensible creatures; among which, by knowing the natures of divers trees, herbes, minerals, &c. we are able to bring any of them to what use soever we find most expedient for our service: from hence grow all those arts and trades, in which we see men dayly spend their whole lives; so as it is needlesse to insift upon the particulars of them, since Townes and the Cities are composed of the severall Tribes of persons that professe them and live by them.

But we must not leave this subject, without noting how admirably mans wit turneth it selfe to so different sorts, and to such an infinite variety of things. For what man is there, (if he be a man) but might have become Master in any of these so differing trades, in case he had applyed himselfe as constantly to that, as he hath done to some other he is perfect in? Again, let us consider how it happeneth often, that hee doth not the same thing twice the same way, but according to his own, or another mans fantasie, changeth his work at will, now doing it after one fashion, now after another; as having no law or determination from nature, but being wholly left to his owne direction.

There remaineth one art, not yet spoken of; which knoweth not where to challenge a place, whether among the moderatours of our owne actions, or among those whereby we govern things: and that is *Arithmeticke*: which seemeth to belong unto things, and yet it medleth not with them: and againe, it seemeth to be a maine directour of our internall actions, and yet belongeth neither to *Morals*, nor to *Logicke*. Wheresoever its due be to place it, I am sure its not to be forgotten; seeing it is so principall an one, as our life can hardly consist without it. It worketh upon notions that are no where; for every thing that is in the world, is but one; and to be, or to make a number, cannot happen without an understanding: the affections likewise of them, are as the subject, all invisible; as to be even or odde, to be cubes, squares, rootes, &c. and yet how great the power and extent of this

I 2.
Of Arithme-
tick.

art is, none can rightly understand or believe, but hee that hath the knowledge of it, or hath scene the vertue and efficacy of it.

15.
Of Prudence.

All these arts, consist in common rules, which require the second of those qualities, whereby we said humane actions are governed, to apply them to their particular matter: and that is *Prudence*; which we may define to be, a quality or power, by whose assistance we apply unto the matter we are to work upon, such instruments, as in our present judgement appeare fittest to bring it to that passe, which serveth best for our intentions, when by our senses, or by other guesies, we know the particular dispositions of the matter, and of the instruments wherewith we are to change it. Now howbeit this occurreth generally in all arts, yet its speciall place and necessity, is in governing and moderating our owne or other mens *Morall* actions; and accordingly, its name is especially addicted thereunto: and that man is said to be prudent or discreet, who governeth himselfe and others well.

This quality of *Morall Prudence* in generall, is divided into three particular ones: the first of which belongeth to a governour in a state or commonwealth: the next may be assigned to to him that is skilfull in the lawes: and the third concerneth the managing and conduct of military actions. The reason of this long received distribution peradventure is, because in these occurrences, our passion swayeth us generally more then in any others: and the operation and effect of *Prudence*, (whose Province is to curbe and moderate our passions by reason) is greatest, and appeareth most in those subjects, where passion raigneth usually with greatest impetuosity.

14.
Observations
upon what
hath been said
in th. is Chap-
ter.

Thus have we runne over the maine parts of discourse; and the generall heads of mans action as man: which peradventure may through their numerousnesse, appeare to bee as it were but loosely scattered from our penne; (as happeneth unto all materials, that must serve for after buildings; and that till they bee employed, require no more but sorting, and laying together in severall heapes, to the end they may bee ready for use:) and therefore before wee goe any further; it will not bee amisse to make reflexions upon what wee have said; and to draw it nearer our intended scope; and to square out and give some figure and polishing

polishing to these stones, here where we digge them out of the quarry, whereby they may hereafter with lesse adoe, fit the places we have assigned them, in the structure we intend: and so, a little trouble here, while our tooles are still in our hands, and our matter lyeth ready for our stroakes, and our thoughts are warmth with working upon them, may save us a great deale there, where our maine employment will bee, to lay artificially; and to joyne closely, what now we but hew out: and therefore will require finer instruments, and a sharper edge, then what at present serveth our turne.

Let us then bring back to account all we have said in this Chapter: and when we have well reflected upon every particular, we shall find they all agree in this, that they are nothing else but a due ordering of one thing with another: a syllogisme is an ordering of some few notions: a science is an ordering of syllogismes, in such sort, as a new Proposition may follow out of those which went before: and as we see that when by our thoughts divers syllogismes are well ordered, hidden things come to be disclosed in our understanding; even so among bodies, if things whose proprieties are knowne, be likewise ordered and put together, those very effects, which were discovered by the ordering of notions in our head, will spring forth in nature: as for example, if by knowing the natures of fire and of towe, our discourse findeth that towe put to fire will presently become fire, the same will happen in nature, if we put materiall towe, or some other body that hath the qualities of it, to reall fire, or to some other substance that is endewed with the vertues of fire: in like manner; if by knowing that colours are nothing else, but various mixtures of light and of darknesse in bodies, our discourse assureth us, that by severall compoundings of these extreames, reds, blewes, yellowes, greenes, and all other intermediate colours may be generated; accordingly wee shall find in effect, that by the severall minglings of black and white bodies (because they reflect or drowne light most powerfully) or by interweaving streames of pure light and of shadowes one with another, wee may procreate new colours in bodies, and beget new luminous appearances to our eyes: so that hence it appeareth clearly, that the same nature is in our understanding, and in the things: and that the same ordering, which in

the one maketh science, in the other causeth naturall transmutations.

Another reflexion, which will be fit for us to make upon these long discourses, is this, that of necessity there must be a joyning of some things now actually in our knowledge, unto other things we think not of: for it is manifest, that wee cannot at the same time actually think of a whole book of Euclide, and yet to the due knowledge of some of the last Propositions, the knowledge of almost all the former is required: likewise it is impossible we should at the same time think of all the multitude of rules belonging to any art, as of Grammar, of Metering, of Architecture; and yet when we write in Latine, make a Poeme, or lay the design of a house, we practise them whiles we think not of them, and are assured we goe not against them, however wee remember them not.

Nay, even before we know a thing, we seem to know it; for since we can have a desire of nothing, but of what we know, how could we desire to know such or such a thing, unlesse wee know both it, and the knowledge of it? And for the most part we see a horse, or man, or herbe, or workmanship, and by our sense have knowledge that such a thing it is, before we know what, or who, or how, it is: that groweth afterwards out of the diligent observation of what we see: which is that, whereby learned men differ from the unlearned, for what striketh the sense, is knowne alike by them both; but then here is the difference betweene them, the latter sort sitteth still with those notions, that are made at the first, by the beating of our sense upon us, without driving them any further: and those that are learned, doe resolve such compounded notions, into others made by more common beatings, and therefore more simple: and this is all the oddes in regard of knowledge, that a Scholler hath of an unlettered man.

One observation more wee will draw out of what wee have said, and then end this Chapter: it is, how a man doth oftentimes enquire among his owne thoughts, and turneth up and down the images hee hath in his head, and beateth his brains, to call such things into his mind, as are usefull unto him, and are for the present out of his memory: which, as we see it so necessary, that without it no matter of importance can bee performed in the way

of

of discourse (whereof I my selfe have too frequent experience in the writing of this Treatise) so on the other side, we cannot perceive that any creature besides Man, doth it of set purpose and formally as Man doth.

THE FOURTH CHAPTER.

How a man proceedeth to Action.

HAVING thus taken a summary view of the principall Qualities a man is endued withall, *Apprehending, Judging, and Discoursing*; and having shewed how he is enriched in and by them with the natures of all things in the world; it remaineth for our last work in this part, to consider in what manner hee maketh use of this treasure in his ordinary actions: which it is evident are of two different kinds, and consequently have two severall principles; Vnderstanding and Sense, they sway by turnes, and sometimes joyne together, to produce a mixed action of both.

I.
That humane actions proceed from two severall principles, Understanding and Sense.

If onely Sense were the fountaine from whence his actions spring, we should observe no other straine in any of them, then meerely that according to which Beasts performe theirs: they would proceed evermore in a constant unvaryable tenour, according to the law of materiall things, one body working upon another, in such sort as we have declared in the former Treatise.

On the other side, if a man were all understanding, and had not this bright lampe enclosed in a pitcher of clay, the beames of it would shine without any allay of dimnesse, thorough all he did; and he could doe nothing contrary to reason, in pursuit of the highest end he hath prefixed unto himselfe; for he neither would, nor could doe any thing whatsoever, untill he had first considered all the particular circumstances, that had relation to his action in hand; and had then concluded, that upon the whole matter, at this time, and in this place, to attaine this end, it is fitting and best to doe thus or thus: which conclusion could be no sooner made, but that the action would without any further disposition on his side, immediately ensue, agreeable to the prin-

principles it springeth from. Both parts of this assertion are manifest: for the first, it is evident, that whensoever an Agent worketh by knowledge, he is unresolved whether hee shall worke or not worke, as also of his manner of working, untill his knowledge (that ought to direct and governe his working) be perfect and complete: but that cannot be, as long as any circumstance not as yet considered, may make it seeme fit or unfit to proceed: and therefore, such actions as are done without exact consideration of every particular circumstance, doe not flow from a pure understanding. From whence it followeth, that when an understanding is not satisfied of every particular circumstance, and consequently cannot determine what he must immediately doe, but apprehendeth that some of the circumstances not as yet considered, may (or rather must) change some part of his action, it must of necessity be undermined in respect of the immediate action; and consequently, it must refrain absolutely from working. The other part is cleare; to wit, that when the understanding, upon consideration of all circumstances, knoweth absolutely what is best, the action followeth immediately (as farre as dependeth of the understanding) without any further disposition on his behalfe: for seeing that nothing but knowledge belongeth to the understanding, he who supposeth all knowledge in it, alloweth all that is requisite or possible for it to worke by: Now if all be put, nothing is wanting that should cause it to worke: but where no cause is wanting, but all requisite causes are actually being, the effect must also actually be, and follow immediately out of them: and consequently, the action is done, (in as much as concerneth the understanding, and indeed absolutely, unlesse some other cause doe faile) as soon as the understanding knoweth all the circumstances belonging to it: so as it is manifest out of this whole discourse, that if a man wrought onely by his understanding, all his actions would be discreet and rati-
 onall, in respect of the end he hath proposed to himselfe; and till he were assured what were best, he would keepe himself in suspense and doe nothing; and as soone as he were so, he would admit of no delays, but would at the instant proceed to action according to his knowledge: the contrary of all which, we dayly see by experience in every man.

We may then safely conclude, that in humane nature there are two different centers, from whence crosse actions doe flow : the one he hath common with beasts, and whose principles and laws we delivered in the former Treatise, where we discoursed of life, and the motions of life and of passions : the other is the subject of our present enquiry ; which in this place, expecteth at our hands, that we should consider how it demeaneth it selfe, and what it doth in us, when by its guidance we proceed to any action. Experience must be our informer in generall : after which, our discourse shall anatomise what that presenteth us in bulke. She giveth us notice of three especiall effects of our understanding : first, that it ordereth aright those conceptions which are brought unto it ; secondly, that when they appeare to be not sufficient for the intended worke, it casteth about and seeketh out others : and thirdly, that it strengthneth those actions which spring from it ; and keepeth them regular and firme and constant to their beginnings and principles. Unto which last seemeth to belong, that it sometimes checketh its own thoughts, and bringeth back those it would have, and appeareth to keep as it were a watch over its owne wayes.

As for the ordering of the present notions, it is cleare that it is done by a secret dependance from the rules of discourse, and from the maximes of humane action : I call this dependance a secret one, because a man in his ordinary course, maketh use of those rules and *maximes* which serve his turne, as though they were instilled into him by nature, without so much as ever thinking of them, or reflecting upon them to square out his actions by them : nay, some of them so far out of the reach of most men, as they cannot think of them, though they would ; for they know them not : as in particular, the rules of discourse ; the use of which is so necessary, as without it no man can converse with another, nor doe any thing like a man, that is, reasonably. From whence then can this proceed, that so familiarly and readily a man maketh use of what he is not conscious to himselfe that he hath any acquaintance withall ? It can be nothing else, but that the soule, being in her owne nature ordered to doe the same thing, which Scholars with much difficulty arrive to know what it is by reflection and study, and then frame rules of that afterwards carry their discourse to a higher pitch, she by an inborne vertue maketh

2.

How our generall and inbred maximes doe concur to humane action,

maketh a man doe it orderly, constantly, and certainly.

3.
That the rules
and maximes of
arts doe worke
positively in us
though wee
think nor of
them.

The like may be observed in the dayly use men make of the *maximes* of humane action: which are certain knowledges that formerly they have gotten, but that they usually think not of, whiles they work agreeable to them; yet it seemeth they work by them; for if their action should jarre against any of them, they would presently reflect upon their *Maxime*, and by it correct what they were about: for example, one who is skilled in the rules of *Grammar*, or of accenting his speech, or hath his eare used to *Musick*; whiles he heareth true construction, or even verse, or consonant song, never reflecteth how it is made; or at most doth but consider in grosse that it is right: but if a solecisme, or false quantity, or discord intervene, he presently is aware, not onely that it is amisse, but remembreth the very particular precise rule, against which the breach is made.

This at the first sight might occasion us to imagine, that the rules by which any composition is made, doe worke onely negatively in us, whiles we are busie about it: that is, that they contribute nothing to the making of the thing, but onely hinder us from committing errors: but if we consider the matter well, we shall find it impossible, but that they should work even positively in us; for we know that when we first learne any of these things, we look industriously for such a gender, or number, or case, or tense, for such a foot or quantity, such a note, or consonance; and we are sure, that use and practice of the same thing, doth not change, but onely facilitate the worke: therefore it followeth of necessity, that we still use those very instructions, by which at the first we could but slowly creepe, but now manage them with such celerity, as our fancie cannot keep pace with what we do. And this is the reason why we do not perceive that we think of them, but may peradventure at the same time think of a quite different matter; as when a Musitian playeth voluntary division upon a ground he never saw before, and yet hath all the while some other thought in his head; or when a Painter draweth a picture, and all the while discourseth with a by-stander.

This truth may be convinced by another argument: as thus; it cannot be doubted, but that a verse or song is made by the power of making such compositions: but that power is the art of them; and that art is nothing else but the rules whereby they are made:

made : and accordingly we see , that who hath not the art, cannot make such compositions : but who hath, can when he pleaseth : and if any man would be able to make them, he presently studyeth the art : so that it cannot be doubted, but that artificiall things are alwayes made by the use of those rules which teach the making of them ; although for the most part we are not able to perceiue how such rules are used : and besides this, we are sure that we doe not onely make use of those rules we learned at the first, but when we are arrived to Mastery in any art, we make use of them in a quite different manner then we did in the beginning, and then we doe in any other thing, wherein we find paine and difficulty.

In the second effect that we experience of our understanding, (which is, our casting about for new conceptions, when those it already hath, appear not sufficient to direct what it hath in hand) the force and working of it, is very evident : for this effect proceedeth out of a want of satisfaction : and this belongeth properly to the understanding ; for if evidence and satisfaction be qualities of it, then of necessity the privation of these qualities, must likewise belong unto it ; as also to discern that privation, and to use meanes to avoid it : and in the very casting about, we see a choice made : and that things are not taken promiscuously as they come of a row, but that some of them are set aside, & others advanced for use : which argueth plainly the knowledge and government of the understanding.

But the third operation, is that which giveth clearest evidence of the peculiar and distinct working of the understanding : for if we mark the contestation and strife within us, between our sensual part and his antagonist which maintaineth the resolution set by reason, and observe how exceedingly their courses and proceedings differ from one another ; we shall more plainly discern the nature, and power, and efficacie of both of them. We may perceive that the motions against *Reason*, rise up turbulently, as it were in billowes, and like a hill of boyling water (as truly *Passion* is a conglobation of spirits) doe put us into an unquiet and distempered heat and confusion : on the other side, *Reason* endeavoureth to keepe us in our due temper ; by sometimes commanding downe this growing sea ; otherwhiles, by contenting in some measure the desires of it, and so diverting another

4.
How the understanding doth cast about when it wanteth sufficient grounds for action.

5.
How reason doth rule over sense and passion.

way its unruly force: sometimes she terrifyeth it, by the profall of offensive things joynd unto those it is so earnest to enjoy: Againe, sometimes she preventeth it, by cutting off all the causes and helps that promote on its impotent desires, and by engaging before hand the power of it in other things, and the like.

All which doe evidently convince, that as *Reason* hath a great strength and power in opposition of sense, so it must be a quite different thing, and of a contrary nature unto it: we may adde, that the worke of *Reason* can never be well performed, but in a great quiet and tranquillity; whereas the motions of *Passion*, are alwayes accompanied with disorder and perturbation: so as it appeareth manifestly that the force of *Reason*, is not purely the force of its instruments, but the force of its instruments as they are guided, and as the quantities of them are proportioned by it: and this force of *Reason*, is different from the force of its instruments in themselves, in such sort as the force of a song, is different from the force of the same sounds, whereof it is composed, taken without that order which the Musitian putteth in them: for otherwise the more spirits that are raised by any thought (which spirits are the instruments whereby *Reason* performeth all her operations in us) the more strongly *Reason* should worke; the contrary of which is evident, for we see that too great abundance of spirits confoundeth *Reason*.

6. This is as much as at present I intend to insist upon, for proove How we recall our thoughts from distractions, that our understanding hath its proper and distinct operations, and worketh in a peculiar manner, and in a quite different strain from all that is done by our senses. Peradventure some may conceive, that the watchfulness and recalling of our thoughts back to their enjoyed work, when they break loose and run astray, & our not letting them range abroad at randome, doth also convince this assertion: but I confesse ingeniously, the testimony of it seemeth not cleare to me; and therefore I ranke it not with those, that I would have (if it may be) solidly weighty, and undenyable to who shall consider maturely the bottome and full efficaciousnes of them. Of such, a few, or any one, is enough to settle ones mind in the beliefe of a truth: and I hope, that this which we have laboured for in this Chapter, is so sufficiently proved, as we need not make up our evidence with number of testimonies.

But

But to shew the exceptions I take against this argument, let us examine, how this act within us which we call watchfulnesse, is performed: truly, me thinketh it appeareth to be nothing else, but the promptitude and recourse of some spirits, that are proper for this effect, which by a mans earnestnesse in his resolution, doe take a strong impression, and so are still ready to knock frequently at the doore of our understanding, and thereby enable it with power to recall our strayed thoughts. Nay, the very reflexion it selfe, which we make upon our thoughts, seemeth unto me to be onely this, that the object beating upon the fanisie, carryeth back with it at its retyring from thence, some little particle or atome of the braine or *Septum Lucidum*, against which it beateth, sticking upon it; in like manner as upon another occasion, we instanced in a ball rebounding from a greene mudd wall, unto which some of the matter of the wall must needs adhere: now this object, together with the addition it getteth by its stroake upon the fanisie, rebounding thence, and having no more to doe there at present, betaketh it selfe to rest quietly in some cell it is disposed into in the braine, as we have delivered at large in our former Treatise, where we discoursed of *Memorie*: but whensoever it is called for againe by the fanisie, or upon any other occasion returneth thither, it commeth as it were capped with this additionall piece it acquired formerly in the fanisie; and so maketh a representation of its own having been formerly there.

Yet, be these actions performed how they will, it cannot be denied, but that both of them are such, as are not fit; nor would be any wayes usefull to creatures, that have not the power of ordering their owne thoughts and fancies, but are governed throughout meerey by an uniform course of nature: which ordering of thoughts, being an operation feasible onely by rati-
 onall creatures, and by none others, these two actions (which would be in vaine, where such ordering is not used) seeme to be specially ordained by nature, for the service of *Reason* and of the *Vnderstanding*; although peradventure a precise proper working of the understanding, doe not cleerely shine in it. Much lesse can we by experience finde among all the actions we have hitherto spoken of, that our *Reason* or *Vnderstanding* worketh singly and alone by it selfe, without the assistance and consortship of
 the

the fantasie: and as little can I tell how goe about to seeke any experience of it.

7.
How reason
is sometimes
overcome by
sense and pas-
sion.

But what *Reason* may doe in this particular, we shall hereafter enquire: and end this Chapter, with collecting out of what is said, how it fareth with us, when we doe any thing against *Reason*, or against our owne knowledge. If this happen by surprize, it is plaine that the watch of *Reason* was not so strong as it should have been, to prevent the admittance or continuance of those thoughts, which worke that transgression. Againe, if it be occasioned by *Passion*, it is evident that in this case, the multitude and violence of those spirits which *Passion* sendeth boyling up to the fantasie, is so great, as the other spirits, which are in the jurisdiction and government of *Reason*, are not able for the present to ballance them and stay their impetuosity, whiles she maketh truth appeare. Sometimes wee may observe, that *Reason* hath warning enough, to muster together all her forces, to encounter, as it were in set battaile, the assault of some concupiscence, that sendeth his unruly bands to take possession of the fantasie, and constraîne it to serve their desires, and by it to bring *Reason* to their bent. Now if in this pitched field shee loofe the bridle, and be carryed away against her owne resolutions, and be forced like a captive to obey the others lawes, it is cleare that her strength was not so great as the contrary factions.

The cause of which is evident; for we know that she can doe nothing, but by the assistance of the spirits which inhabit the braine: now then it followeth, that if she have not the command of those spirits which flock thither, she must of necessity be carryed along by the streame of the greater and stronger multitude; which in our case, is the throng of those that are sent up into the braine by the desired object; and they come thither so thick and so forcibly, that they displace the others which fought under *Reasons* Standard: which if they doe totally, and excluding *Reasons* party, doe entirely possesse the fantasie with their troupes, (as in madnesse and in extremity of sudden passion it happeneth) then must *Reason* wholly follow their sway, without any struggling at all against it; for whatsoever beateth on the fantasie, occasioneth her to worke; and therefore when nothing beateth there but the messengers of some sensuall object, she can
make

make no resistance to what they impose : but if it happen that these tumultuary ones, be not the only spirits which beat there, but that *Reason* hath likewise some under her jurisdiction, which keep possession for her, though they be too weak to turne the others out of doores; then it is true, she can still direct fairely, how in that case a man should govern himselfe; but when he cometh to execute, he findeth his sinews already possessed, and swelled with the contrary spirits; and they keeping out the smaller and weaker number, which reason hath ranked in order, and would furnish those parts withall, he is drawne even against his judgement and *Reason*, to obey their appetites, and to move himself in prosecution of what they propose; in such sort as the Poet expresseth that *Medea* found in her selfe, when she complained and bemoaned her selfe in these words; *Video meliora proboque, Deteriora sequor*: and in this case, a man foreseeth his misery all the way he roaleth towards it, and leapeth into the precipice with his eyes open: which sheweth that the Army of thoughts on *Reasons* side, should be increased in number, to have her strong enough to wage battle with the rebellious adversary: or else, that her adversary should be so much weakned, that she, though not grown stronger in her selfe, yet might, through the others enfeebling, be able to make her party good; (and hence is the use of corporeall mortifications, to subject our *Passions* to the behest of *Reason*) even as when wee see, that when we are in health, our armes, and legs, and all our limbes, obey our will, reaching what we command them, and carrying us whither we desire, because the spirits which are sent into them from our braine, are strong enough to raise and move them as they are directed; but if our sinewes be so steeped in some cold and watry humour, that the spirits coming downe, find net means to swell and harden them; well we may wish and strive, but all in vain: for we shall not be able to make them perform their due functions. In like manner, if *reason* doe send her emissaries into the same arm or leg or other member, and no other spirits doe there strive against them, then that limb is moved and governed absolutely according to her directions: but if at the same time, a greater multitude of others, do hinder *Reasons* servants from coming thither, or flocking into other sinews, doe carry that limb a contrary way; in vain doth *Reason* strive to move them to her byas; for those obeying parts must observe the rules which the violent conqueror prescribeth.

THE F I F T C H A P T E R .

Containing proofes out of our singular apprehensions, that our soule is incorporeall.

I.
The connection of the subsequent chapters with the precedent.

AS in our first Treatise we dissected nature, and shewed, how out of the notion and first division of Quantity, ariseth that vast multiplicity of things, which filling this world, falleth under the consideration of our senses: so in the beginning of this second Treatise, we have searched into those operations of a man (attributed to his soule) by which he is conceived to excell all other living creatures: and there discovered, that the admirable, and unlimited variety of works, which is seen in mens writings and actions, doth all flow from the source of *single apprehensions*; and even from one bare notion of *Being*: which is the root and principle, from whence all others derive their origine; and into which all may be resolved; works proceeding from resolutions, they from discourses, these being composed of judgements, and judgements of single apprehensions. This part we must now review, and enquire what we can find in mans operation, arguing the *Quality* of his Soul, whether it be corporeall or no. For if these single apprehensions, and the processes compounded of them, may be performed by the ordering of rare and dense parts (as the other works of nature are) then they will be corporeall, and of the same kind with those, which we opened in the first Treatise: but if we shall prove, that they cannot possibly be deduced from multiplicity, and order of Quantitative parts, when we may confidently resolve our selves, that in the cause from which they flow, is a nature wholly discrepant from that which resideth among bodies, and among corporeall things.

This we shall here labour to doe: and to that end, we will begin our work with reflecting upon what we have delivered of a single apprehension, in the first Chapter of this second Treatise: whose nature we there first explicated in common; and thence proceeded to some particular apprehensions; and lastly shewed the extent they comprehended. These then must be the subject of our present speculation.

As for their nature, we may remember, how we resolved three things: first, that by apprehension, the very thing apprehended is by it selfe in our soule: next, that the notion of *Being*, is the first of all notions, and is resumed in all others: and thirdly, that what is added to the notion of *Being*, is but *respects* to other things. Now then let us consider, what kind of Engines they must be, that may have the power to make things themselves to be in our soule, if they were to bee there materially? How shall the place, or the time passed, be removed, and be put in another place, and in another time? How shall the quantity of the heavens, of the whole world, nay of bignesse exceeding all that by millions of proportionall encreases, be shut up in the little circuite of mans braine? And if we examine our selves strictly, we shall find nothing wanting; all is there. How shall the same thing, be corporeally in two, nay in two thousand places, at the same time? And yet, in so many is the sunne, when two thousand men think of it at once. We must then allow, that things are there immaterially; and consequently, that what receiveth them, is immateriall: since every thing is received according to the measure and nature of what receiveth it.

But I easily conceive, that the strangeness and incredibility of our position, may counterballance the force of it: for who can perswade himselfe, that the very thing he apprehendeth, is in his mind? I acknowledge, that if its being there, were to be understood corporeally, it were impossible: but on the other side, who shall consider, that he knoweth the thing he rightly apprehendeth, that it worketh in him, and maketh him work agreeable to its nature, and that all the properties and singularities of it may be displayed by what is in him, and are as it were unfolded in his mind, hee can neither deny nor doubt, but that it is there in an admirable and spirituall manner. If you aske me how this cometh to passe? And by what artifice, bodies are thus spiritualized? I confesse I shall not bee able to satisfy you: but must answer, that it is done, I know not how, by the power of the soule: shew me a soule, and I will tell you how it worketh: but as we are sure there is a soule, (that is to say, a *Principle* from whence these operations spring) though we cannot see it: so we may, and doe certainly know, that this mystery is as we say; though because we understand not the true and compleat nature

2.

The inexistence of corporeall things in the soule by the power of apprehension, doth prove her to be immateriall.

nature of a soule, we can as litle expresse the manner, how it is done by a soule. Yet, before we take our leave of this matter of *Apprehensions*, we will in due place endeavour to say something towards the clearing of this obscure point.

3.
The notion of
being, which is
innate in the
soule, doth
prove the same.

Our second consideration upon the nature of *Apprehension*, was, that our primary and maine notion, is of *Being*. This discovereth some litle glympse of the nature of the soule: for it is manifest that she applyeth this notion, as well to no parts, as to parts: which we proved in the first Treatise, when we shewed that we have a particular notion of *substance*, distinct from the notion of *Quantity*; for quantity and parts being the same, it followeth that if there be a notion supposed by quantity, (as in substance there is) it must of necessity abstract from parts: and consequently, wee may conclude, that the notion of *Being*, which is indifferently applyable either to quantity or to substance, doth of its owne nature wholly abstract either from *Parts*, or from no *Parts*. I then inferre: that since this notion of *Being*, is the very first and virgin notion our soule is imbued with or is capable of, and that it is the root of all other notions, and into which shee resolveth every other notion, in such sort, as when we have sifted and searfed the essence of any notion whatsoever, we can discover nothing that is deeper then this, or precedent to it, and that it agreeth so compleatly with our soule, as she seemeth to be nothing else but a *capacity fitted to Being*, it cannot be denied, but that our soule must needs have a very neare affinity and resemblance of nature with it: but it is evident, that *Being* hath not of it selfe any parts in it, nor of it selfe is capable of division: and therefore it is as evident, that the soule which is framed (as it were) by that patterne and Idea, and is fitted for *Being* as for its end, must also of it selfe be voyde of parts, and be incapable of division. For how can parts be fitted to an indivisible thing? And how can two such different natures ever meet proportionably?

If it be objected, that the very notion of *Being*, from whence wee estimate the nature of the soule, is accommodable to parts: as for example, wee see that substance is endewed with quantity. We answer, that even this doth corroborate our prooffe: for seeing that the substances, which our senses are acquainted withall, have parts, and cannot be without parts; and yet neverthelesse

lesse in our soule, the notion of such substance is found without parts; it is cleare, that such substance hath this meerly from our soule: and because it hath this indivisibility from our soule, it followeth that our soule hath a power and nature to bestow indivisibility upon what cometh into her. And since it cannot be denied, but that if any substance were once existent without parts, it could never after have parts; it is evident, that the nature of the soule is incapable of parts, because it is existent without parts. And that it is in such sort existent, is cleare: for this effect of the soules giving indivisibility unto what shee receiveth into her, proceedeth from her as shee is existent. Now since this notion of *Being*, is of all others the first and Originall notion that is in the soule, it must needs above all others, favour most of the proper and genuine nature of the soule: in which, and by which, it is what it is, and hath its indivisibility.

If then it be pressed; how can substance (in reality or in things) be accommodated unto Quantity, seeing that of it selfe it is indivisible? Wee answer, that such substance, as is the subject of *Quantity*, and that hath *Quantity*, is not indivisible; for such substance cannot be subsistent without *Quantity*; and when we frame a notion of it, as being *indivisible*; is it an effect of the force of our soule, that is able to draw a notion out of a thing that hath parts, without drawing the notion of the parts: which sheweth manifestly, that in her there is a power above having of parts: which being in her, argueth her existence to be such.

Our last consideration upon the nature of apprehension, was, how all that is added to the notion of *Being*, is nothing else but *respects* of one thing to another; and how by these *respects*, all the things of the world come to be in our soule. The evidence we may draw from hence of our soules immateriality, will be not a whit lesse, then either of the two former: for let us cast our looks over all that commeth into our senses, and see if from one end to another, we can meet with such a thing as we call a *respect*: it hath neither figure, nor colour, nor smell, nor motion, nor taste, nor touch; it hath no similitude to be drawne out of by meanes of our senses: to be *like*, to be *halfe*, to be *cause*, or *effect*, what is it? The things (indeed) that are so, have their resemblances and pictures; but which way should a Painter goe about to

4.
The same is proved by the notion of *respects*.

draw a *likenesse*? Or to paint a *halse*, or a *cause*, or an *effect*? If we have any understanding, we cannot choose but understand, that these notions are extreemly different, from whatsoever cometh in unto us by the mediation of our senses: and then if we reflect, how the whole negotiation of our understanding is *in*, and by *respects*; must it not follow necessarily, that our soule is of an extreame different nature from our senses, and from our Imagination? Nay, if we look well into this argument, wee shall see, that whereas *Aristotle* pretendeth, that *Nihil est in intellectu quod non prius fuit in sensu*; this *Maxime* is so farre from being true, (in rigour of the words) that the quite contrary followeth undeniably out of it; to wit, that *Nihil est in intellectu quod fuit prius in sensu*. Which I doe not say to contradict *Aristotle* (for his words are true in the meaning he spoke them;) but to shew, how things are so much changed by coming into the understanding and into the soule, that although on the one side, they be the very same things, yet on the other side there remaineth no likenesse at all between them in themselves as they are in the understanding; which is a most evident prooffe, (when the weight of it is duely considered) that the nature of our soule, is mainly different from the nature of all corporeall things, that come into our sense.

5. By this which we now come from declaring, the admiration, how corporeall things can be in the soule, and how they are spiritualized by their own being so, will in part be taken away: for reflecting that all the notions of the soule, are nothing but the generall notion of a *substance*, or of a *thing* joyned with some particular *respect*; if then we consider, that the respects may be so ordered, that one respect may be included in another, we shall see, that there maybe some one respect, which may include all those respects that explicate the nature of some one thing: and in this case, the generall notion of a *thing* coupled with this respect, will contain all whatsoever is in the thing: as for example, the notion of a knife, that it is a *thing* to cut withall, includeth (as we have formerly declared) all that belongeth unto a knife. And thus you see, how that mysticall phrase, of corporeall things being spiritualized in the soule, signifieth no more, but that the similitudes which are of them in the soule, are *Respects*.

6. Thus having collected out of the nature of *Apprehension* in common, as much as we conceive needfull in this place to prove

our assertion, our next work must be, to try if we can doe the like, by reflecting upon particular *apprehensions*. We considered them of two sorts, calling one kind, *universall* ones; and the other, *collective* ones: in the *universall* ones, we took notice of two conditions, the *abstraction*, and the *universality* of them: now truly if we had no other evidence, but what will rise from the first of these, that alone would convince and carry the conclusion: for though among corporeall things, the same may be now in one place, now in another, or sometimes have one figure, sometimes another, and still be the same things, as for example wax or water; yet, it is impossible to imagin anybodily thing whatsoever, to be at any time without all kind of figure, or without any place at all, or indifferent to this or to that; and nevertheless, all things whatsoever, when they are *universally* apprehended by the soule, have this condition in her by reason of their *abstraction* there, which in themselves is impossible unto them. When we say, water, fire, gold, silver, bread, &c. doe we mean or expresse any determinate figure? If we doe, none but that precise figure, will serve or content us: but it is evident, that of a hundred different ones, any and every one doth alike intirely satisfy us: when we call for mony, if we reflect upon our fancy, peradventure wee shall find there a purse of crowns: nevertheless, if our messenger brings us a purse of pistols, we shall not except against it, as not being what we intended in our mind, because it is not that which was painted in our fancy: it is therefore evident, that our meaning and our fancy were different; for otherwise, nothing would have satisfied us, but that which was in our fancy. Likewise in the very word (which is the picture of our notion) we see an indifferency; for no dictionary will tell us, that this word *Mony* doth not signify as well pistols as crowns: and accordingly we see, that if our meaning had bin precisely of crowns, we should have blamed our selves for not having named crowns, and not him that brought us pistols, when we spoke to him by the name of mony: and therefore it is most cleare, that our understanding or meaning is not fixed or determined to any one particular; but it is equally indifferent to all: and consequently, that it cannot be like any thing which entreth by the senses; and therefore not corporeall.

The second condition of *Universall Apprehensions*, is their *universality* which addeth unto their *abstraction*, one admirable particularity

7.
That the universality of abstracted notions doth prove the same.

cularity, and it is, that they abstract in such sort, as to expresse at the same time even the very thing they abstract from. How is it possible that the same thing can be, and not be in the same notion? Yet let a man consider what he meaneth when he saith, *every man hath two eyes*, and he shall see that he expresth nothing, whereby any one man is distinguished from another: and yet the force of this word *Every*, doth expresse that every man is distinguished from another; so that in truth, he expresth particularity it selfe in common. Now let our smartest and ingeniouest adversary, shew or imagine if he can, how this may be done in a picture, or in a statue, or in any resemblance of a body or bodily thing: but if he can not, let him acknowledge an eminent and singular propriety in the soule, that is able to doe it.

Let us reflect, that particularity in a body, is a collection of divers qualities and circumstances; as that it is white, of such a figure, in such a place, in such a time, and an infinitude of such like conditions, conglobated together: then if our soul be a body, the expression of the particularity of a body in the soul, must be a participation in her of such a conglobation, or of such things conglobated. Now let us imagine if we can, how such a participation should be in common, and should abstract from all colour, all place, and all those things of which the conglobation consisteth, adn yet we see, that in the soul this is done; and he who saith *Every man*, doth not expresse any colour, place, or time, and nevertheles he doth by saying so expresse, that in every man there is a conglobation of colour, place, and time: for it could not be *Every one*, unles there were such conglobations to make *Every one, one*: & if any conglobation were expressed in this term *Every one*, it would not be *Every one*, but only *one alone*. Now if any coordination of parts can unfold and lay open this riddle, I will renounce all Philosophy & understanding.

8.

That collective apprehensions doe prove the same.

Collective apprehensions will afford us no meaner testimony then the other two, for the spirituality of our soule: for although it may seem unto us, before we reflect throughly on the matter, that we see, or otherwise discern by our sense, the numbers of things; as that the men in the next roome, are three; that the chaires there, are tenne; and the like of other things; yet after due consideration, we shall find, that our eye, or sense telleth us but singly of each one, that it is *one*; and so runneth over every one of them; keeping them still each by themselves, under their owne severall

unities :

unities: but then the understanding commeth; and joyneth under one notion, what the sense kept asunder in so many severall ones, as there are *things*. The notion of *three*, or of *ten*, is not in the *things*, but in our mind; for why three rather than five, or ten rather than twelve, if the matter of which we speak were not determined? and such determination of the matter, is an effect of the understanding. If I had spoken of *things*, as I did of men, or of chaires, there had been more than three or ten: it is then evident, that what determined my speech, made the number be three or tenne.

Againe, we see that the notion of *ten*, is but one notion; for as the name of *ten*, is but one signe, so it argueth, that there is but one notion, by which it is the signe of ten things. Besides, we see that Arithmeticians doe find out the proprieties and particular nature of any determinate number: and therefore we may conclude, that every number hath a definition, and a peculiar nature of its owne, as it is a number. If then this definition, or nature, or notion of *ten*, be a corporeall one, it is a corporeall similitude of the object. But is it like to any one of the things, or is it like to all the ten? If to any one, then that one will be ten; if it be like to the whole made of ten, then that whole being but one, ten will be just one, and not ten things.

Besides, to be *ten*, doth expressly imply to be *not one*: how then can that be a materiall thing, which by being one representeth many? Seeing that in materiall things, *one* and *many* are opposite, and exclude one another from the same subject? And yet, this notion could not represent many together, but by being one.

Againe, if it be a materiall notion or similitude, it is eyther in an indivisible of the braine, or it is in a divisible part of it: I meane, that the whole essence of the notion be in every part never so little of the braine, or that one part of the essence, be in one part of the braine, and that another part of the essence, be in another part of the brain. If you say, that the whole essence is in every part of the braine, though never so little; you make it impossible that it should be a body; for you make it the likenesse of ten determinate bodies, in an indivisible manner; seeing that what by division groweth not lesse, hath the nature of an indivisible: but if you say, that divers parts of the essence, are in divers parts
of

of the braine, then you make it impossible that the notion of tenne, should be indivisible; since it selfe is composed of severall parts.

In a word, tenne things cannot be represented materially, but by ten other things: and therefore it is most evident, that the soule which representeth ten by one thing or notion, doth not represent the tenne materially: and consequently, that her self is immateriall.

What we have now said, will be confirmed by considering the termes, *All* and *whole*: for it is cleare, that these termes also, are of the nature of numbers; but withall, doe expresse particularly that no part is wanting. If then the notion of *All* or *whole*, be said to be materiall or quantitative, it must be divisible: but if you divide it, no part remaineth *All* or *whole*: it is not therefore divisible; and consequently it is not materiall. And as this argument is manifestly applyable to numbers, so if we looke into the arguments concerning numbers, you will find all them likewise applyable to these termes, *All* and *whole*.

9.
The operations of the soule drawing alwayes from multitude to unity, do prove the same.

Out of what hath been hitherto discovered, we may gather this note: that it is the nature of the soule, to draw from divisibility, to indivisibility; from multitude, to unity; from indeterminatenesse and confusion, to a clarity and determination: as appeareth evidently in this last example of *Collections*; in which, whether we take numbers, or other collective termes, we see that throughout their natures doe consist in such a perfect indivisibility, as no part can be separated without destroying the essence of the notion: nay, things which in themselves are many and consist in parts, doe in the mind get an impartible nature; for *ten*, is no longer *ten*, if it be divided: nor *all*, is *all*, if any thing be taken away. In the same manner, though Philosophy teach us, there be neither points in bignesse; nor instants in motion or time, yet nature maketh us expresse all bignesse by points, and all time by instants; the soule ever fixing it selfe upon indivisibility.

And this is the reason; why we attribute the nature of substance to all our notions: if we see a thing white, or black, or doe, or suffer, or be in a place, or in time; presently in our apprehensions we conceive these modifications of the thing, like substances; and accordingly we call them by substantive names, *Whitenesse*, *Action*,

Action, Vbication, Duration, &c. Now the reason of this is, because a substance, (that is terminated within it selfe) is a fit and a steady ground for the soule to fixe it selfe upon, whereas these other Appendixes of substance, would not afford her easie footing to build her structures upon, if she considered them as truly they are in themselves: and therefore in her notion, she giveth them the qualities of substance: but withall it happeneth many times, that by her doing thus, if she be not very wary, she is deceived and falleth into grosse errors.

One thing more we must remember to take notice of; and it is, that if we will compare the notions in our understanding, with the signes which beating in our fanſie doe beget those notions; we shall find, that these are but barely signes: and doe not in their owne nature expresse, eyther the notions they raise, or the things they are signes of. This is evident in the images of the sounds we call *words*: for it is cleare, they have no likenesse either with the things they signifie, or with the thoughts they beget in us: and we shall find it no lesse true of other images; for example, in the exterior impressions of sensible *qualities*, which seeme by themselves to be in the understanding; for if we consider the matter well, we shall perceive that we understand nothing more by them, then we doe by meere words; and that to worke, or to discourse out of them, we must seek into the objects, and their definitions; whereof we learne nothing by thote first impressions: for it seemeth, that (for example) hot, or red, or sweet, to a man that first seeth, or feeleth, or tasteth them, signifyeth nothing else, but a thing which maketh such an apprehension in his soule, or such a phantasmie in his interior sense; and neverthelesse, as yet the man knoweth not that he hath a soule, or an interior sense; nor doth reflect so farte as to consider, that this motion passeth by his exterior sense; but his apprehension is immediately carried to the thing without him; and hee imagineth that the impression he feeleth, is in the thing he feeleth; and so hee that should feele himselfe heated by a burning glasse, and were not acquainted with the vertue of such a glasse; would think the glasse were hot: yet certainly, his first apprehension is of the motion made in his fanſie, (though he imagineth it elsewhere) which he conceiveth to be the nature of the thing that maketh it. And thus we see that the conversion of the soule, is immediate to a thing without

10.

The difference betwixt the notion of a thing in our understanding, and the impression that correspondeth to the same thing in our fanſie, doth prove the same.

without the man : which also is the effect of her being fixed to *Existence* ; for by reason of that, she still apprehendeth every impression as a *thing*.

But now, whether her apprehension doth include the very impression, which is in the sense or in the fanſie, so that by its own likenesse it be in the soule, or whether the impression in the fanſie maketh a change in the soule, which we cannot discern in it selfe, but conceive it to be the impression which is in the fanſie, because that impression is at the first continually present at the said mutation ; is more obscure and hard to discover. But when we reflect that after some time, words doe succeed in lieu of this impression, and doe performe the same effect as the originall impression, in what language soever they be uttered, so they be understood ; we may conclude out of this evident signe, that the impression is in the understanding not in its owne likenesse, but in another shape, which we doe not discover ; and which is excited, as well by the name, as by the impression, in a man that is used to the names.

Againe, in a man that learneth things by himself, these impressions serve for words, and not for things ; for such a man never looketh into his fanſie to discourse upon any thing, but onely upon the mutation he conceiveth is made in the externe sense : out of which he gathereth by little and little, the nature of the thing, whose notion was made at first in him by this impression. Out of which it is manifest, that our knowledge is as different a thing, from the Phantasmes which beat at the soules doore, as the thing signified is from the sound of the word, or as the wine in the cellar is from the bush : and therefore, it is impossible that the soule (in which that knowledge resideth, and which indeed is that knowledge) should be a corporeall or bodily thing : since of all bodily things, the motions that are made by the sensible qualities, arrive neereſt to a spirituall nature.

II.
The apprehension of negations and privations do prove the same.

It remaineth now, that we should argue for the immateriality of the soule, out of the extent of our *apprehension* : which seemeth to be so excessive, as not to be comprehensible by the limitations of bodies ; and therefore cannot belong unto a body : but because all that needeth to be said in this particular, followeth plainly out of grounds already urged, and that this point containeth not any notable particularity deserving mention here ; we will not enlarge

large our selves any further upon it, but will passe on to the next line of operations proper unto our mind.

Only we may not omit taking notice of the expressions which our mind maketh of *nothing*, or as Logicians terme it, of *Negations* and *Privations*: which doe argue an admirable power in the soule, and of a quite different straine from all corporeall things; and doe evidently convince the immateriality of it: for it cannot be doubted, but that the soule knoweth what she meaneth, when she discourseth of *Nothing*. Now if all her knowledge, were nothing else but corporeall phantasmes, or pictures made by corporeall things, how should she come to have a notion of *Nothing*? for since it is most cleare, that *something* cannot be like *Nothing*, and that there cannot be a participation of what *is not*; how can we conceive that there should be a similitude made of *Nothing*?

The way therefore that the soule taketh in this operation, is, that comparing two things together, and finding that the one of them is not the other; she reflecteth upon her owne action, and dividing in it the thing said, from the saying, she taketh the thing said for a quality, or property, or predicate (as Logicians call it) of that thing which she denyeth to be the other thing; and then she giveth it a positive name, after she hath first made a positive notion, unto which the name may agree: as for example, when the soul considereth a man that hath not the power to see, as soon as she hath to her selfe pronounced, that he hath not such a power, she taketh the *not power to see*, for a quality of that man; and then giveth the name of *blindnesse* to that *not power of seeing*; which though of it selfe it be nothing, yet by being that which satisfieth her act, when she saith that he hath not the power of seeing, it seemeth to be ranked among those things, unto which names are due: for it hath a notion; and the having a notion, is the clayme, or merit, or dignity, in vertue whereof things are preferred to names.

Now then, let us enquire how the power of rarity and density, or the multiplication and order of parts, can be raised and refined to the state of being like *nothing*, or of being the similitude of a *negation*; or what operation of rarity or density, can forge out this notion of *blindnesse*, which we have explicated: and when we find, it is beyond their reach to compasse, we must acknow-
ledge,

ledge, that the soule is another kind of engine, then all those which are in the storehouse of bodies.

THE SIXT CHAPTER.

Containing proofes out of our soules operations in knowing or deeming any thing, that she is of a spirituall nature.

I.
The manner of judging or deeming by apprehending two things to be identified, doth prove the soule to be immateriall.

OUr next consideration shall be to see what testimony our manner of *judging*, doth yeeld us of the nature of the soule: concerning which, three things offer themselves, worthy the reflecting on; which are, our manner of thinking; the opposition which frequently occurreth in our thoughts; and the nature of truth and of falshood. As for the first, we may remember how we have shewed, that all *judgement* or *deeming* is but an apprehension of identification, or something immediately following out of it: and that a settled *judgement* or *assent of the mind* is as it were a limbe, or branch, or graft in our soule; so that we finde that our perceiving of identification between two things, or our seeing that the one is the other, is that by which our soule encreaseth. Now, because when two things are identified, the one reacheth not further then the other, it is clear that this increase of the soule is not made by parts, which being added one to another do cause it to be greater: and therefore, since this latter course is the only means of increase in bodies and in quantity, it is as clear that the nature of the soule, is quite different from the nature of all corporeall or Quantitative things.

Againe, it is against the nature of identification, to be of parts; and therefore, they who take quantity to be one thing, and not many things tyed together, doe acknowledge that truly there are no parts in it: and this is so rigorously true, that although wee speak of two things that in reality are identified one with another, yet if our words be such, as imply that our understanding considereth them as distinct parts, and by abstraction giveth them the nature of parts; then they are no longer identified, but in good Logick, we ought in this case to deny the one of the other. As for example: though the hand and the foot be the same thing, (as we have declared in our first Treatise) yet because in the name
hand,

hand, there is a secret exclusion of any thing that is not in the definition of a hand, it followeth that in our speech we must say, that a hand is not a foot. Likewise though it be confessed, that the thing which is *rationality* is also *risibility*; neverthelesse, it is a solecisme in Logick, to say that *rationality* is *risibility*; because it is the nature of these abstracted names, to confine their significations to one definition; and the definitions of these two termes are divers. Out of this consideration it followeth clearly, that seeing the nature of parts, is contrary to the nature of identity; and that the soule in her judgements worketh altogether by identity, it is impossible that her operations should consist of parts, or in any sort resemble any proceeding of Quantitative things.

The like will be convinced out of the opposition we finde in our thoughts. In it we may consider two things: first the generation of it: next, the impossibility of opposites in the soul. To begin with the first: we see that in our speaking, opposition is produced by the addition of this word *Not*: as when we say, *not a man, not a penny, not a word*: and therefore it followeth, that in our soule there is a notion of it, correspondent to the word that expresseth it. Now, seeing that a notion is a thing, and that it is the likenesse of its object, or rather the same with the object: let us cast about, how we should of parts and of quantity, make a *nothing*, or an identification to *not*: and when we find, that it is ridiculous and absurd to goe about it, let us conclude, that the manner of working, which our soule useth, is far different from that which is used in bodies, and among materiall things.

And if you object, that not onely a body, but even any other substance whatsoever (suppose it as spirituall as you will) cannot be either like, or identified to *nothing*; and therefore this argument will as well prove that the soule is not a thing or substance, as that it is not a body: we answer, that it is evident out of what we have already said, that the understanding is not the objects it understandeth, by way of similitude, but by a higher meanes; which we have shewed to be by way of *Respects*. Now then, the respect which the thing hath to another thing, by not having such a respect unto it, as a third thing formerly considered hath thereunto, may be expressed in way of *Respects*, though it cannot in way of similitude: and so our understanding is able to expresse, what

2.

The same is proved by the manner of apprehending opposition in a negative judgment.

what neyther our fansie, nor any corporeall thing can arrive to the expression of: as when first we finde, that one man hath a respect to the wall, which we call the power of seeing it; if afterwards we find that another man hath a respect unto the wall of impotence, that he cannot see it, this second respect the understanding hath a power to expresse as well as the first: as we have touched above.

3.
That things in themselves opposite to one another having no opposition in the soule, doth prove the same.

As for the opposition that occurreth in our thoughts, we may consider it of two kinds: the one is of the things or objects that come into our thoughts or into our soule and this is not properly an opposition in the soule; for although the things be opposite by their owne nature in themselves, yet they doe not exercise their opposition in the soule: nay, though the opposition be even in the soule it selfe, if the soule with this opposition, be considered as an object, it maketh no opposition in the soule; for so you may consider your soul learned and unlearned, ignorant & knowing, good and bad, and the like: all which are oppositions in a soule supposed to be so qualified, but are no oppositions in a soule that considereth them: no more then fire and water, heavy things and light, white and black, being and not being, an affirmative proposition and its negative, and the like: all which are in themselves so contrary and opposite to one another, that they cannot consist together in one subject; they have an impossibility among themselves, wheresoever the one of them is, by its very entrance it driveth out its opposite: and yet in the soul they agree together without reluctance: she knoweth and considereth and weigheth both sides of the scale at the same time, and ballanceth them evenly one against another: for unlesse both the opposites were in the same instant in the same comparing power, that power could not by one act whose beginning implyeth its ending, judge the difference and opposition of them: as when we say *black is contrary to white, or darknesse is the want of light*, we pronounce one common *not being* of both extremes.

We may then boldly conclude, that since no body whatsoever can entertaine at the same time, and in the same place, these quarrelling Antagonists, but that by their conflict, they presently destroy one another, and peradventure the body too, into which they presse for entrance, and the entire possession of which each of them striveth for; (those of them I meane, that are proportioned

tioned to the reception of bodies) and that the soule imbibeth them together without any difficulty or contrast, and preserveth them alwayes friends even in the face of one another, and lodgeth them together in the same bed; and that (in a word) these opposite things doe enjoy an admirable and unknowne manner of *Being* in the soule, and which hath no parallel nor argument in bodily things : wee may (I say) boldly conclude, that the soule it selfe, in which all these are, is of a nature, and hath a manner of *Being* altogether unlike the nature of bodies, and their manner of *Being*.

Out of this agreeing of all objects in the soule, and their having no opposition there, even whiles shee knoweth the opposition that is between them in themselves, (there followeth another consideration, of nolesse importance : which is, that the amplitude of our soule in respect of knowledge, is absolutely infinite; that is to say, shee is capable of knowing at the same time objects without end or measure. For the explicating whereof, we are to consider, that the latter conclusions, which the soul gaineth knowledge of, doe hang to the former by identification, or by the soules seeing that two notions are identified, because they are identified to a third, as is before expressed; and the first principles which seem to be immediately joyned unto the the soule, have the identity of their termes plaine and evident, even in the very termes themselves. Nay, if we insift further, wee shall find that the first truths must have an identification to the very soule it selfe; for it being evident that truth or falshood, is not in the soule but so farre forth, as she doth apply her selfe to the externall object, or to the existence of things in themselves; and that we find that the soules knowing with evidence that any thing *is* or *hath being*, implyeth her knowing that her selfe *is*; (for shee cannot know that a thing seemeth so to her, or maketh such an impression in her, without knowing that her selfe *is*; though peradventure she may not know what her selfe is, but taketh her selfe to bee no other thing then the body of the man in which shee is) it is evident that the first truths which enter into the soule, to wit, that this or that seemeth so or so unto her, (and these truths no scepticke ever doubted of) are identified with the soule it selfe ; seeing that an

4.
That the first truths are identified to the soule.

object seeming to be such or such, is nothing else, but the soule is so qualified.

And in this we find, that the certainty of the first *Principles*, as for example of this Proposition, *That the whole is bigger then the Part*, will depend in a particular soule of her certainty of her owne *Being*: for although this Proposition would have a necessity in the very connexion of the termes, notwithstanding there were not in nature any *whole* or *Part*; yet this necessity would not be a necessity of *Existence* or of *Being* in the object, but a necessity of connexion, as it were of two parts of the soule: and so, if verity and falsity be not perfectly in the soule, but in the comparison to actuall existence, the soule would not be perfectly true, or (to say more properly) would not have the perfection of truth in her, by having or knowing this Proposition, unlesse withall she were certain, that there were existent, an object of this Proposition: of which (as we have said) she cannot be certain, without being certain of her owne *Being*; so that in effect, the identification of other things among themselves, by which such things are knowne, doth come at the last to be retrived in the existence of the soule it selfe, and to be in the soule, by the identification of those other things unto her selfe.

5. Now then to proceed to the prooffe of our proposed conclusion, it is cleare, that the adding of one thing to another, doth out of the force of this addition, perfect the thing unto which the addition is made, if the advenient thing be added in such way, as the former is apt to receive it: but it is evident, that the soule is made fit by former Propositions, to be identified to latter ones; for wee see that the former ones draw on, and inferre the latter ones: and therefore it followeth, that the more is added to the soule, the greater is her aptitude to have more, or to bee more encreased: and consequently, that the more is added unto her, the more may still bee added; and the more capable and more earnest shee is, to have more. Wherefore it cannot be denied, but that since in the nature of the objects there is no impediment to hinder their being together in the soule, (as wee have proved a little above) and that in her by receiving new objects into her, there is a continuall encrease of capacity to receive more; shee hath an amplitude to knowledge absolutely

That the soule hath an infinite capacity, and consequently is immateriall.

absolutely infinite, in such a manner as we have above expressed.

Now to apply to our purpose what we have gathered by this discourse; it is cleare, that these two conditions of *one thing not driving out another*, and of *infinity of accessions*, doe openly disclaime from quantity, and from matter; for we see that what hath Quantity, or is a body, cannot admit a new thing into it, unless some other thing doe first goe out of it, to make roome for the advenient one: and as for infinitude, it breedeth a sea of contradictions, if it be but thought of in Quantity: and therefore we may conclude, that the soule, unto whom these two conditions doe belong, is not quantitative or corporeall, but immateriall, and of a spirituall nature.

The second kind of opposition, that occurreth in our thoughts, or in our soule, is of *Contradictory Propositions*: it hath its origine in the opposition of *Being* to not *Being*: and is when a thing is identified unto the soule, in such sort as we have said, that a *Judgment* or *Deeming* maketh the object become as it were a limbe, or part of the soule: and because the conflict of two such Propositions, if they were together in the soule, would make her be something contrary to the nature of *Being* (if any thing can be contrary to *Being*) which in the schooles they call *ens & non ens*; the impossibility of her admitting into her selfe two such Propositions together, doth testify her firme cleaving and her fixednesse to *Being*: and so doth confirme and bring new evidence to that argument for the soules spirituality, which in the sixth Chapter of this part, we drew from the nature of *Being*.

As for truth and falshood, they spring from the same root as the last; as being qualities consequent to the opposition of affirmative and negative Propositions; whereof if the one be true, the other must necessarily be false: and therefore, we need not spend time in setting down any particular considerations of these; since what we have said of the other, is applyable unto them: but it is sufficient, that we thus note them, to give the Reader occasion to reflect upon them.

Among Propositions, there are some which Logicians doe term of *Eternall truth*: and out of these, there are ingenious men, who imagine that the immortality of the soule may be immediately deduced. Herein they rove not quite from the marke; though

6. That the opposition of contradictory Propositions in the Soule doth prove her immateriality.

7. How Propositions of eternall truth, doe prove the immateriality of the soule.

withall I must needs say, they doe not directly hit it. To understand the utmost that may be inferred out of such Propositions, we may note two conditions in them: the first is, that generally these Propositions are universall ones; and thereby have that force to convince the spirituality of the soule, which we have explicated and shewed to belong unto universall termes: the second is, that in these Propositions, there is a necessity of connexion between their termes; such an one, or at the least very like thereunto, as we explicated in those Propositions, which beare their evidence plaine in their very termes. And out of this we may draw another argument for the spirituality of the soule: for wee see that all corporeall agents and patients, are defectible and contingent; that is to say, sometimes, or if (if you will) most times, they attaine their effect; but withall, sometimes (be it never so seldom) they misse of it: and accordingly, it happeneth sometimes that our eyes, our eares, our touch, and the rest of our senses are deceived; though for the most part, they give us true informations of what they converse with: but these Propositions of eternall verity doe never faile: they have in themselves an indefectibility insuperable; and consequently, they give evidence that the soules nature is of a higher degree of constancy and certainty, then what falleth within the compasse of bodies: and is of a nobler and different straine, from all corporeall things: for this certainty is entayled upon such Propositions by the force of *Being*; which is the proper object of the soule: and they have their *Being*; as limbes and parts of the soule.

As for the terme of *Eternall verity*, it is not to be taken positively, as if these Propositions, or their objects, had any true eternity or perseverance, without beginning or ending: but only negatively; that is, that there can be no time, in which they are false: and therefore, we cannot out of their having such a kind of Eternity belonging to them, argue a capacity of infinite time or duration in our soule that comprehendeth them.

THE SEVENTH CHAPTER.

*That our discoursing doth prove our soule to bee
incorporeall.*

HAVING thus runne over those proofes for the immateriality of our soule, which arise out of her manner of working when shee judgeth; in the next place, wee are to enquire what others, her manner of discoursing will afford us. Wee are sure, that since our discourse is composed of judgements, and of single apprehensions, it cannot choose but furnish us with all those pregnant arguments, that wee drew from them. But that will not serve our turne: wee look after new evidence: and wee shall see it will give it us with full hands. It consisteth in this: that when wee discourse, wee may easily perceive there is more at one time in our mind, then we can discover to be in our fantasie; for we find, that in our fantasie, as one Proposition commeth, another is gone: and although they that are gone, seeme to be ready at a call, yet they are not in presence; as being things which consist in motion, and that require place; and therefore the one justleth the other out of the place it possessed. But if it fared in like manner in our inward soule, we could never attain unto knowledge: for it is manifest, that our soule is not assured of a conclusion, but by her seeing the premisses: if then the premisses be taken away, the conclusion that resteth upon them, falleth to the ground: but they are taken away, if they be out of our mind: therefore, when our understanding yeeldeth its assent to a conclusion, it must of necessity have the premisses still in it.

But we must not rest here; this consideration will carry us on a wonderous deale further: wee know, that who so goeth to frame a new demonstration in any subject, must be certain he taketh nothing contrary to what he hath learned in many bookes: likewise, that who will make a latine verse, or readeth a Poeme, knoweth there is nothing in all that Poeme contrary to his Prosodia: doe we not then manifestly perceive a certaine remainder of all these in his soule? The like is in all arts: in which he

I.
That in discoursing the soul containeth more in it at the same time then is in the fantasie, which proveth her to be immateriall.

that goeth about any work according to art, sheweth hee hath in his head all the rules of that art, though he doe not distinctly remember them, or call them to mind whiles he worketh: for if he have them not, how doth he work by them? Since then it is cleare that he thinketh not of them at that time, it is as cleare, that more is in the soule at one time, then is in his fantasie, or then can be there by materiall bodies, (which wee have shewed is the way, whereby all things come into the fantasie) although it be the nimblest and the subtillest Agent of all corporeall things whatsoever.

2.

That the nature of discourse doth prove the soule to be ordered to infinite knowledge, and consequently to be immateriall.

Another consideration whereby to evince the immateriality of the soule, concerneth the proceeding of syllogismes by linkes, fastned one to another: whence we may take notice, that every one of them is a step to another: and consequently, it is manifest that according to the nature of the soule, they must bee altogether in her: since, if any one were absent, all the rest that followed and depended upon that one, would have no grounding, nor fixednesse in the soule. Now if to this we adde, that what is to be knowne, is absolutely and liquidly infinite, there cannot be brought or expected a more pregnant and home-witnesse of our soules spirituality: it following out of these grounds; that the soule by its nature, is not only capable of, but is expressly ordered to an infinite knowledge of infinite objects altogether; for these two, *finite* and *infinite* science, are so vastly different from one another, that if the same subject bee capable of both, it must of necessity be ordered to infinite, as to its chiefest act and end: and thus out of *capacity* in this subject, *its being ordered* is well inferred; though in other matters peradventure the consequence may not be good. And accordingly who looketh into *Geometry*, *Arithmeticke*, *Logicke*, or even *nature* it selfe, will evidently see that the objects of knowledge, are every way, and in every science, multiplyable without end.

3.

That the most naturall objects of the soule are immateriall, and consequently the soule her selfe is such.

Neither ought this to bee neglected, that a great part of the soules objects, and indeed of those that are most naturall to her, is above the capacity, and out of the reach of materiall things. All Metaphisicks abstract from quantity: the investigation of God, of Angels, of the soule it selfe, either concludeth immateriality, or at the least worketh about it.

What

What shall I say of Logically notions, of those which are called the *second intentions*; about which there is so much business both in the schooles and in the world? It is sufficient that wee have already expressed, how all our notions are *relative*. But in particular the motives of humane actions are very abstracted considerations: as for example, hope of things to come, memory of things passed, vertue, vice, honour, shame, and the like. To these let us adde, that when wee teach or explicate any thing to ignorant persons, we must frame out owne apprehensions to their capacity, and wee must speak such things as they may comprehend: which capacity or extent of comprehension wee cannot see nor perceive by any sense, but wee judge it meere by our Reason, and by our understanding. Wherefore, seeing that our operation is mainly and chiefly on and by such motives, as are not lyable to materiall principles and compositions, it is evident, that the spring-head from whence such an operation floweth, must also be immateriall and incorporeall.

I am not ignorant, that this argument useth to be answered by urging, that the soule likewise knoweth *Deafnesse*, *Dumbnesse*, *Blindnesse*, and such other notions of *Nothings*; and yet is not from thence inferred to be *nothing*: it conceiveth God and Eternity; and yet it is neither from it selfe, as God is, nor eternal. In like manner (say they) it may know incorporeall things, and yet not be therefore it selfe incorporeall. To this I reply, first wishing them not to mistake me, but to give my argument its full force and weight: for there is a very great difference between the knowing of a thing, in a strained, toyle some, and confused manner, and the having a thing for its ordinary matter and subject of negotiation: this argueth connaturality between the soule and what it is in such sort conversant about; but that doth not. Now what is inferred out of whole sciences and arts, concerneth a maine stock of the soules business, and not some extraordinary vertue or powers she hath.

But to come up to close to the answer: I say, that if wee being thoroughly acquainted with materiall things, can find that it is not in the possibility of any such to be the likenesse of an immateriall thing; and from thence doe inferre that our soule, for being

fraught with immateriall notions, is not materiall; our conclusion is well collected, and a very good one; for the premisses out of which we doe gather it, are within our kenning; and therefore if there were any defect in the consequence, wee should easily perceive it. Whence it appeareth clearly, that there is no parity between the deduction of our conclusion, and that other which the objection urgeth, that our soule, because it can know eternall things, is also eternall; for eternity is a thing beyond our comprehension: and therefore it ought not to be expected at our hands, that we should be able to give an account where the brack is. And to say the truth, if *knowledge* be taken properly, we doe not know eternity; however by supernaturall helps we may come to know it: but in that case, the helps are likely to bee proportionable to the effect. Neither are negations properly knowne, seeing there is nothing to bee knowne of them. And thus we see that these objections doe proceed from the equivocation of the word *knowledge*; sometimes used properly, other-times applyed abusively.

THE EIGHT CHAPTER.

Containing proofes out of our manner of proceeding to action, that our soule is incorporeall.

I.

That the soules being a power to order things proveth her to be immateriall.

I Doubt not but what we have already said, hath sufficiently convinced our soules being immateriall, unto whomsoever is able to penetrate the force of the arguments wee have brought for proofe thereof, and will take the paines to consider them them duely: (which must bee done, by serious and continued reflection, and not by cursary reading, or by interrupted attempts) yet since wee have still a whole field of proofes untouched, and that in so important a matter, no evidence can be too clear, nor any paines be accounted lost, that may redouble the light, although it shine already bright enough to discern what we seek, we will make up the concert of unanimous testimonies to this already established truth, by adding those arguments wee shall collect out of the manner of our soules proceeding to action,

unto

unto the others we have drawn from our observations unto her apprehensions, her judgements, and her discourses.

Looking then into this matter: the first consideration we meet withall is, that our understanding is in her owne nature an *orderer*; and that her proper work is to rank and put things in order: for if we reflect upon the workes and arts of men, as, a good life, a common-wealth, an army, a house; a garden, all artefacts; what are they, but compositions of well ordered parts? And in every kind, we see that he is the Master, and the Architect, and is accounted the wisest, and to have the best understanding, who can best, or most, or further then his fellowes, set things in order. If then to this we joyne, that Quantity is a thing whose nature consisteth in a capacity of having parts and multitude, and consequently is the subject of ordering and ranking; doth it not evidently follow, that our soule, compared to the whole masse of bodies, and to the very nature of corporeity or quantity, is as a proper agent to its proper matter to worke upon? Which if it be, it must necessarily be of a nobler straine, and of a different and higher nature then it; and consequently, cannot be a body, or be composed of Quantity: for had it matter in it selfe, what it expecteth and requireth from the agent, it would not need the agents help, but of it selfe it were fit to be an Agent. Wherefore if the nature of corporeity, or of body, in its full latitude, be *to be ordered*, it followeth that the thing whose nature is to be an *orderer*, must as it is such, be not a body, but of a superiour nature, and exceeding a Body: which we expresse by calling it a *spirituall thing*.

Well then, if the soule be an *orderer*, two things belong necessarily unto her: The one is, that she have this order within her selfe; the other is, that she have power to communicate it unto such things, as are to be ordered. The first she hath by science, of which enough already hath been said towards proving our intent. Next, that her nature is communicative of this order, is evident out of her action and manner of working. But whether of her selfe she be thus communicative, or be so by her conjunction to the body she informeth, appeareth not from thence. But where Experience falleth short, Reason supplyeth, and sheweth us that of her owne nature she is communicative of order;

for

2.

That the soules being able to move without being moved, doth prove her to be immateriall.

for seeing that her action is an *ordering*, and that in this line there are but two sorts of things in the world, namely, such as do order, and such as are to be ordered; it is manifest, that the action must by nature and in the universall consideration of it, begin from the *orderer* (in whom order hath its life and subsistence) and not from that which is to receive it: then, sithence *ordering* is motion, it followeth evidently that the soule is a mover and a beginner of motion.

But since we may conceive two sorts of movers; the one when the agent is moved to move; the other, when of it selfe it beginneth the motion without being moved; we are to enquire, unto which of these two the soule belongeth. But to apprehend the question rightly, we will illustrate it by an example: let us suppose that some action is fit to begin at ten of the clock: now we may imagine an agent to begin this action in two different manners; the one, that the clock striking ten, breedeth or stirreth somewhat in him, from whence this action followeth; The other manner is, that the agent may of his own nature, have such an actuall comprehension or decurrence of time within himselfe, as that without receiving any warning from abroad, but as though he moved and ordered the clock as well as his owne instruments, he may of himselfe be fit and ready, just at that houre to begin that action; not as if the clock told him what houre it is, but as if he by governing the clock, made that houre to be, as well as he causeth the action to begin at that houre. In the first of these manners, the agent is moved to move; but in the second, he moveth of himselfe, without being moved by any thing else. And in this second way, our soule of her owne nature communiceth her selfe to quantitative things, and giveth them motion: which followeth out of what we have already proved, that a soule, in her owne nature, is the subject of an infinite knowledge, and therefore is capable of having such a generall comprehension, as well of time, and of the course of all other things, as of the particular action she is to doe; and consequently, standeth not in need of a Monitor without her, to direct her when to begin.

If then it be an imprevaricable law with all bodies, that none whatsoever can move unlesse it bee moved by another;

it followeth, that the soule which moveth, without being stirred or excited by any thing else, is of a higher race then they; and consequently is immateriall and voyd of Quantity. But let me not bee mistaken in what I come from saying; as though my meaning were, that the soule exerciseth this way of moving her selfe, and of ordering her actions, whiles shee is in the body: for how can shee; seeing shee is never endewed with compleate knowledge requisite for any action; never fully comprehending all the circumstances of it? But what I intend, is that the nature of the soule, considered in it selfe, is such, as hath a capacity and may reach to this manner of working, (whence I inferre that shee is not a body but a spirit) without determining, whether she worke thus in the body, or out of it: that enquiry belongeth not to this place; it will follow by and by.

But for the present, having considered unto what kind of working, the nature of the soule in abstract, is capable of attaining; we will conclude this Chapter with reflecting upon those actions of hers, which fall daily under our remarke, as being exercised in the body. In all of them we may observe, that she proceedeth with a certaine universality and indifferency, beyond the practice of all other creatures whatsoever. For example, if a man be spoken to, or asked of a hundred severall things that he never thought of before in all his life, he will immediately shape pertinent replies, to all that is said, and returne fitting answers to every question: As; *Whither such a man goeth? How long this staffe is? What colour that mans clothes are of? &c.* To all which, and to as many things more as you will, (so they be within the compasse of his knowledge) he straight answereth differently, and to the purpose. Whence it is manifest, that his answers doe not proceed upon set gimals or strings, whereof one being struck, it moveth the rest in a set order, (which we have shewed, is the course in all actions done by beasts) but out of a principle within him, which of it selfe is indifferent to all things; and therefore can readily apply it selfe to the answer, according as by the question it is moved: and the like may be observed in his actions; which he varyeth according to the occasions presented.

5.
That the soules proceeding to action with an universality, & indifferency, doth prove the same.

I remember how Sir *Philip Sidney* (the Phoenix of the age he lived in, and the glory of our nation, and the patterne to posterity of a compleat, a gallant, and a perfect Gentleman) aptly calleth our hands, the instruments of instruments; from *Aristotle*, who termeth them *Organa organorum*, or universall instruments, fitly moulded to be employed in any service; whereas nature hath to all other creatures appropriated their instruments to determinate actions, but to man, she hath (in these) given such, as might be applyed to any kind of work whatsoever: and accordingly we see, that the same kind of bird, still buildeth her nest, and breedeth her young ones, in the same way, without any the least variance at all: but men do build their houses as they please, sometimes upon hills, sometimes in vales, sometimes under the earth, and sometimes upon the tops of trees: and the manners of breeding or instructing their children, are as divers, as the customes of nations and townes: and in all other actions, our Masters note it for a property peculiar to Man, that hee useth to arrive unto the same end by divers means, as to transport our selves unto some place wee would goe unto, eyther by water, or by horse, or by coach, or by litter, as we please: whereas we see no such variety in like actions of other living creatures.

All which being so, we may conclude, that the soules proceeding either to answers, or to action, argueth cleerly that shee hath within her selfe such an indifferencie, as is joyned with a means to determine this indifferencie: the contrary whereof we see in all corporeall engines; for they have every step in the whole course of their wayes, chalked out unto them, by their very framing, (as hath been amply declared in the first Treatise) and have the determination of their worke, from end to end set downe, and given them by their artificier and maker: and therefore it is most evident, that the soule cannot be a thing composed or framed of materiall and quantitative parts, seeing shee hath not her wayes set downe unto her, but frameth them of her selfe, according to the accidents that occur.

4.

That the quiet proceeding of reason doth prove the same.

The same nature of the soule, discovereth it selfe in the quiet proceeding of *Reason*, when it worketh with greatest strength and vigour; as well knowing, that its efficaciously consisteth

not

not in the multitude of parts, which *Passion* breedeth, but in the wel ordering of those it already hath under its command. Whereas the strength of Quantity, and the encrease of its strength, consisteth in the multitude of its parts; as will evidently appeare to whom shall consider this point deeply.

Thus we have in a summary manner gone through all the operations of the soule, which in the beginning of this latter Treatise, we heaped together as materials, wherewith to raise an immateriall and spirituall building. Neither, I hope, will our Reader be offended with us, for being more succinct and concise in all our discourse concerning our soule, then where wee delivered the doctrine of Bodies: for the difficultnesse of this subject, and the nicety required to the expressing our conceptions concerning it, wherein (as the proverb is) a haire is to be cloven, would not allow us that liberty of ranging about, as when we treated of Bodies. What occurreth among them, may be illustrated by examples within their owne orbe, and of their owne pitch; but to display the operations of a soule, we can finde no instances that are able to reach them; they would rather embroile and darken them: for the exact propriety of words, must be strictly and rigorously observed in them: and the Reader shall penetrate more into the nature and depth of them, by serious meditation and reflection upon the hints we have here given, (efficacious enough, I hope, to excite those thoughts he should have for this purpose, and to steere them the right way) then by much and voluminous reading, or by hearing long and polished discourses of this subject.

For my part, if what I have here said, should to any man appeare not sufficient to convince that our soule is of a spirituall and far different nature, from all such things as in our first Treatise we have discoursed upon, and taken for the heads and most generall kinds of Bodies, (unto which all other particular ones, and their motions may be reduced) I shall become a suitor to him, in entreating him to take this subject into his handling, where it beginneth to be unwieldy for mine, and to declare unto us, upon the principles we have settled in the first Treatise, and upon considering the nature of a body, (which is the first of all our notions) how these particulars wee have reflected upon in

5.

A conclusion of what hath been said hitherto in this second treatise.

mans actions, can be drawne out of them; for I can finde no possible meanes to linke them together: a vast and impenetrable Ocean, lyeth betweene the discoveries we have made on each side of its shores, which forbiddeth all commerce between them; at the least, on the darke bodies side, which hath not wings to soare into the region of *Intellectuall* light. By those principles, we have traced out the course and progresse of all operations belonging to sense; and how beasts doe or may performe all their actions, even to their most refined and subtilest operations: but beyond them, we have not been able to carry these grounds, nor they us. Let him then take the pains to shew us, by what figures, by what first qualities, by what mixtion of rare and dense parts, an univerrall apprehension, an evident judgement, a legitimate consequence is made: and so of the like; as, of a mans determination of himselfe to answer pertinently any question; of his choosing this way before that, &c. Which if he can doe (as I am sure he cannot) I shall allow it to be reason, and not obstinacie, that worketh in his mind, and carryeth him against our doctrine: but if he cannot, and that there is no apparance nor possibility (as indeed there is not) that these actions can be effected by the ordering of materiall parts, and yet he will be still unsatisfied, without being able to tell why, (for he will be unwilling to acknowledge, that these abstracted speculations, doe not sinke into him, and that nothing can convince him, but what his senses may be judges of, and that he may handle, and turne on every side like a brick or a tile) and will be still importune with cavillous scruples, and wild doubts, that in truth, and at the bottome doe signifie nothing, we will leave him to meditate at his leisure upon what we have said; whiles we proceed on to what followeth out of this great principle, *That our soule is incorporeall and spirituell.*

THE NINTH CHAPTER.

That our Soule is a Substance, and Immortall.

HAVING concluded that our Soule is immateriall and indivisible; to proceed one step further, it cannot be denied, but that it is either a substance or an accident; if the latter, it must be of the nature of the substance whose accident it is; for so we see all accidents are: but in man when his soule is excluded, there is no spirituall substance at all, whereof we have any notice: and therefore if it be an accident, it must be a corporeall accident, or some accident of a body; as some figure, temperature, harmony, or the like: and consequently, it must be divisible: but this is contrary to what is proved in the former Chapters: and therefore it cannot be a corporeall accident. Neither can it be a spirituall accident; for unto what spirituall substance should it belong, when as nothing in man can be suspected to be spirituall, but it selfe. Seeing then that it can be no accident, a substance it must be, and must have its *Existence* or *Being* in it selfe.

Here we have passed the Rubicon of experimentall knowledge: we are now out of the bounds that experience hath any jurisdiction over: and from henceforth, we must in all our searches and conclusions relie onely upon the single evidence of Reason. And even this last conclusion we have been faine to deduce out of the force of abstracted reasoning upon what we had gathered before; not by immediate reflection upon some action we observe proceeding from a man: yet withall, nature flasheth out by a direct beame, some little glimmering of the verity of it, to the eye of Reason that is within us: for as when we see a clock move, or a mill, or any thing that goeth by many wheels, if we mark that there are two contrary motions, in two divers parts of it, we canot think that those contrary motions, do belong to one and the same continued body, but shall presently conclude, that there must be in that engine two severall bodies compacted together; so in man, though his body be the first mover that appeareth unto us, yet seeing that in his actions, some effects doe shew themselves,

which

1.
That Mans
Soule is a
substance.

2.
That Man is
compounded of
some other sub-
stance besides
h's body.

which it is impossible should proceed from a body, it is evident, that in him there is some other thing besides that one which we see: and consequently we may conclude, that he is composed of a body and of somewhat else that is not a body: which *somewhat else*, being the spring from whence those actions flow, that are of a different straine from them that are derived from the body, must necessarily be a spirituall substance.

3.
That the soule
doth subsist of it
selfe independ-
ently of the
body.

But whiles we are examining, how far our present considerations, and short discourses may carry us, as it were experimentally to confirme this truth, we must not omit what *Avicenna* in his book *De Anima & Almahad*, and *Monsieur des Cartes* in his Method, doe presse upon the same occasion. Thus they say, or to like purpose: If I cast with my selfe, who I am that walk, or speak, or think, or order any thing; my reason will answer me, that although my legs or tongue were gone, and that I could no longer walk or speak, yet were not I gone, and I should know & see with my understanding, that I were still the very same thing, the same *Ego* as before. The same as of my tongue or legs, would reason tell me of my eyes, my eares, my smelling, tasting, and feeling, eyther all of them together, or every one of them single, that were they all gone, still should I remaine: As when in a dreame, (where I use none of all these) I both am, and know my selfe to be. Reason will tell me also, that although I were not nourished, so I were not wasted, (which for the drift of the argument may be supposed) yet still I should continue in *being*. Whence it would appeare, that my heart, liver, lungs, kidneys, stomach, mouth, and what other parts of me soever, that serve for the nourishment of my body, might be severed from me, and yet I remain what I am. Nay, if all the beautifull and ayrie fantasmes, which fly about so nimbly in our brain, be nothing else but signes unto in our soule, of what it is without us; it is evident, that though peradventure she would not without their service, exercise that which by error we mis-name *Thinking*; yet the very same soule and thinker might be without them all: and consequently, without braine also; seeing that our braine is but the play-house and scene, where all these saery masks are acted: so that in conclusion Reason assureth us, that when all body is abstracted in us, there still remaineth a substance, a thinker, an *Ego*, or *I*, that in it selfe is no whit diminished, by being (as I may say) stripped out of the case it was inclosed in. And

And now I hope the intelligent Reader will conceive I have performed my promise, and have shewed the Soule of man to be an *Immortall substance*: for since it is a *substance*, it hath a *Being*; and since it is immateriall substance, it hath a *Being* of its owne force; without needing a consort body, to helpe it to sustaine its *Existence*: for to be a substance, is to be the subject of *Existence*; and consequently, to be an immateriall substance, is to be a subject capable of *Existence*, without the helpe of matter or of *Quantity*. It can not therefore be required of me, to use any further industry, to prove such a soule to be immortall: but who will contradict her being so, is obliged to shew that she is mortall: for it followeth in reason, that she will keepe her *being*, unles by some force she be bereaved of it; it being a rule, that who-soever putteth a thing to be, is not bound, for the continuation of that things being, to prove that it is not changed: but on the other side, he that averreth it is changed, is bound to bring in his evidence of a sufficient cause to change it: for to have a thing remaine, is natures owne dictamen and followeth out of the causes which gave it *being*: but to make an alteration, supposeth a change in the causes; and therefore the obligation of prooff lyeth on that side.

Nevertheless, to give satisfaction to those, who are earnest to see every article positively proved, we will make that part too our *Province*. Let us then remember, that *Immortality* signifyeth a negation, or a not having of *Mortality*: and that a positive terme, is required to expresse a change by; since nature teacheth us, that what soever is, will remaine with the *Being* it hath, unlesse it be forced out of it: if then we shew, that Mans soule hath not those groundes in her, which maketh all things we see, to be mortall; we must be allowed to have acquitted ourselves of the charge, of proving her *Immortall*. For this end let us looke round about us, and inquire of all the things we meete with, by what means they are changed, and come to a period, and are no more. The pure elements will tell you, that they have their Change, by rarefaction and condensation, and no otherwise: mixed bodies, by alteration of their mixture: small bodies, by the activity of the Elements working upon them; and by the means of rare-

4.
Two other arguments to prove the same: one positive, the other negative.

5.
The same is proved because the soule can not be obnoxious to the cause of mortality.

faction and condensation entering into their very constitution, and breeding another temperament, by separation of some of their parts, and in their stead mingling others. Plantes, and trees and other living creatures will tell you, that their nourishment, being intimated through their whole bodies; by subtile pores, and blinde passages, if they either be stoped by any accident, or else be fill'd with bad nourishment; the mixture of the whole faileth of it selfe, and they come to dye. Those things which are violently destroyed, we see are made away, for the most part by division; so fire by division destroyeth all that commeth in its way; so living creatures are destroyed by their parting of their blood from their flesh, or of one member from an other, or by the evaporation or extinction of their naturall heat. In fine, we are sure that all things, which within our knowledge loose their *Being*, do so by reason of their Quantity; which by division, or by rarefaction, and compression, gaineth some new temperature, that doth not consist with their former temper. After these premisses, I need say no more: the conclusion displayeth it selfe readily and plainly, without any further trouble; for if our labour hath bene hitherto, to shew that our soule is indivisible, and that her operations are such as admit not quantitative parts in her; it is cleare, that she can not be mortall, by any of those ways whereby we see things round about us to perishi.

The like argument we may frame out of locall motion; for seeing that all the alterative actions we are acquainted withall, be performed by locall motion (as is delivered, both in grosse, and by detaile, in our first Treatise) and that Aristotle, and all understanding Philosophers doe agree; there can be no locall motion in an indivisible thing (the reason whereof is evident, to whomsoever reflecteth upon the nature of *Place*, and of *locall motion*) it is manifest, that there can be no motion to hurt the soule, since shee is concluded to be *indivisible*.

The common argument likewise used in this matter, amounteth to the same effect: to wit, that since things are destroyed only by their contraries; that thing which hath no contrary, is not subject to destruction: (which Principle both Reason and experience, do every where confirme:) but a humane soule is not subject to contrariety: and therefore such an one can not be destroyed.

The same is proved because the soule hath no contrary.

stroyed. The truth of the assumption, may be known two wayes: first, because all the contrarieties that are found within our cognition, do rise out of the primary opposition of *Rarity*, and *Density*; from which the soule being absolutely free, she likewise is so, from all that groweth out of that rout: and secondly, we may be sure, that our soule can receive no harme from contrariety; since all contraries are so far from hurting her, as contrary wise, the one helpeth her in the contemplation of the other: & as for contradiction in thoughts, which at different times our soule is capable of admitting, experience teacheth us, that such thoughts do change in her, without any prejudice to her substance, they being accidents and having their contrariety only betwixt themselves within her, but no opposition at all to her; which only is the contrariety that may have power to harme her: and therefore, whethersoever of such contrary thoughts be in the soule, pertaineth no more to her subsistence, then it doth to the subsistence of a body, whether it be here or there, on the right hand, or on the left.

And thus I conceive my taske is performed; and that I am discharged of my undertaking to shew the soules *Immortality*, which importeth no more, then to shew, that the causes of other things mortality, do not reach her. Yet being well perswaded, that my reader will not be offended with the addition of any new light, in this darke subject; I will strive to discover (if it be possible) some positive prooffe, or guesse, out of the property and nature of the soule in selfe, why she must remaine, and enjoy another life after this. To this end let us cast our eye backe, upon what hath bene already said, concerning her nature. We found that *truth* is the naturall perfection of Mans soule; and that she can not be assured of truth naturally, otherwise then by evidence: & therefore it is manifest, that evidence of truth, is the full compleat perfection, at which the Soule doth ayme. We found also, that the soule is capable of an absolute infinity, of truth or evidence. To these two, we will ad only one thing more, which of it selfe is past question, and therefore needeth no prooffe; and then we will deduce our conclusion and this is, that in a man his soule is a farre nobler, and perfecter part of him, then his body: and therefore by the rules of nature, and of wisdom, his body was made for his soule, and not his soule finally for his body.

7.
The same is proved from the end for which the soule was created.

These groundes being thus layed, let us examine, whether our soule doth in this life arrive to the end she was ordained for, or no: and if she do not then it must follow of necessity, that our body was made but for a passage, by which our soule should be ferried over into that state, where she is to attaine unto that end for which her nature is framed and fitted: the great skill, and artifice of nature, shewing and assuring us that she never faileth of compassing her end, even in her meanest workes: and therefore without doubt would not breake her course in her greatest, whereof *man* is absolutely the head and chiefe, among all those that we are acquainted with Now, what the end is, unto which our soule doth ayme, is evident; since the perfection of every thing, is the *end* for which it is made, the perfection then, and end of the soule being *evidence*, and she being capable of infinite *evidence*; let us inquire, whether in this life she may compass it or no. To determine this question, let us compare infinite *evidence*, to that *evidence*, which the greatest and most knowing man that ever lived, hath acquired by the worke of nature alone; or to the evidence, which by ayme we may imagine is possible ever to happen unto any one man to arrive unto: and balancing them well together, let us judge whether all that any man can know here, is not in respect of what a mans soule is capable of, to be stiled as nothing, and deserveth not the name of *evidence*, nor to be accounted of that nature: and if our sentence do conclude upon this, let us acknowledge, that our soule arriveth not to her perfection, nor enjoyeth her end, in this world, and therefore, must have infallibly an other habitation in the next world, unto which nature doth intend her. Experience teacheth us that we can not fully comprehend any one of natures workes: and those Philosophers, who in a disciplinable way search into nature, (and therefore are called Mathematicians) after they have written large volumes of some very slender subject, do ever find, that they have left untouched, an endlesse abisse of knowledge for whomsoever shall please to build upon their foundations and that they can never arrive neere saying all that may be said of that subject though they have said never so much of it. We may not then make difficulty to beleve, that the wisest and learnedest men, in the world, have reason to professe with the father of Philosophers, that indeed they know nothing. And if so, how far are they

they from that happinesse & perfection, which consisteth in knowing all things? Of which full sea, we never thelesse finde even in this low ebbe; that our soule is a channell capable, and is framed a fit vessell and instrument to receive it, when the tide shall come in upon it, which we are sure it can not do, untill the bankes of our body which hinder it, be broken downe.

This last consideration, without doubt, hath added no small corroboration to our former proofes; which are so numerous and so cleare, as peradventure it may appeare superfluous, to say any more to this point; since one convincing argument establisheth the verity of a conclusion, as efficaciously as a hundred; and therefore Mathematicians use but one single prooffe in all their Propositions; after which other supernumerary ones, would be but tedious neverthelss, since at the severall wayes, by which we may look into the nature of our soule (the importantest subject we can busy our thoughts upon) can not faile of being pleasing and delightfull to us, we must not omit to reflect a little upon that great property of our soule, by which she is able to move and to worke, without her selfe being moved or touched. Vnto which adding, that all Life consisteth in motion, and that all motion of bodies commeth from some other thing without them; we may evidently conclude, that our soule, who can move without receiving her motion from a bread, hath in her selfe a spring of life; for the which she is not beholding (as Bodies are) to some extrinsecal cause of a nature like unto her; but only to him, who gave her to be what she is. But if she have such a spring of Life within her, it weare unreasonable to imagine, that she died upon the occasion of the death of another thing, that exerciseth no action of life, but as it is caused by another.

Neither may we neglect that ordinary consideration, which taketh notice, that our soule maketh use of Propositions of eternall truth, which we have above produced, among our proofes for her being of a spirituall nature; and shall now employ it for the proving her *Immortal*: by considering, that the notion of *Being*, which lenteth these Propositions so, as they feare no mutation or shaking by time, is the very roote of the soule; and that which giveth her her nature, and which sheweth it selfe in all her operations: so that, if from *Being*, arriveth unto these Propositions, to feare no time, the like must of necessity betide also the sub-

8.
The same is proved because she can move without being moved.

9.
The same is proved from her manner of operation which is grounded in being.

stance of the soule. And thus we see, that her nature is out of the reach of time : that shee can comprehend time, and set it limits, and that shee can thinke of things beyond it, and cast about for them. All which are cleare testimonies, that she is free and secure from the al-devouring and destroying tyranny of that Saturniall Conquerour of the whole world of matter and of bodies, whose servant is death.

10.
Lastly it is
proved from
the science of
Morality, the
principles
whereof would
be destroyed if
the soule were
mortal.

After all these proofes drawn from the nature of the soule it selfe, every one of them of force to convince her immortality, I must crave leave to adde one consideration more, though it seemeth to belong unto an others harvest, namely to the science of Moralls : and it is ; that the position of Mortality in the Soule, taketh away all morality, and changeth men into beasts ; by taking away the ground of all difference in those things, which are to governe our actions. For supposing that the soule dyeth with the body ; and seeing that man hath a comprehension or notion of time without end ; it is evident, that the spanne of this life, must needs appeare contemptible unto him that well considereth and weigheth it against the other infinite duration : and by consequence, all the goods, and evils which are parts of this life, must needs become as despicable and inconsiderable : so that better or worse in this life, hath not any appearance of difference betweene them ; at the least, not enough to make him labour with paine to compass the one, and eschew the other, and for that end, to crosse his present inclination in any thing, and engage himselfe in any the least difficult taske : and so it would ensue, that if to an understanding man, some course or action were proposed unto him, as better then that he were going about, or for the instant had a minde unto, he would relish it, as a great marchant, or a Banquier would doe, who dealing for Milions, one should presse him with earnestnesse, to make him change his resolved course, for the gaine of a farthing more this way then the other ; which being inconsiderable he would not trouble his head with it, nor stop at what he was in hand with. In like manner, whosoever is perswaded, that for an infinite of time he shall bee *nothing*, and without sense of all things, hee scorneth for this iittle twinckling of his life, to take any present paines, to be in the next moment well, or to avoyd being ill ; since in this case dying is a secure remedy to any present evill ; and hee is as ready to dye now, as a hundred yeares hence ; nor can he esteeme the losse of a hundred yeares, to bee a matter of moment :
and

and therefore he will, without any further guidance or discourse be- take himselfe to doe whatsoever his present inclination beareth him to with most facility; upon this resolution, that if any thing crosse him, he will presently forgoe his life, as a trifle not worth the keeping: and thus, neither vertue, nor honour, nor more pleasure then what at the present tickleth him, doth fall into his account: which is the overthrow of the whole body of *Mortality*, that is of mans action and nature. But all they who looke into sciences, doe crosse that for an erroneous and absurd position, which taketh away the Principles of any science: and consequently, the position of the soules *Mortality*, is to bee esteemed such. There remaineth yet one consideration more, and peradventure more important, then any we have yet mentioned, to convince the soules immortality: which is, that spirituall things are in a state of *being*. But we shall not be able to delate this untill we have proceeded a little further.

CHAP. X.

Declaring what the soule of a man, seperated from his body, is: and of her knowledge and manner of working.

VN happy man! how long wilt thou be inquisitive and curious to thine owne perill? Hast thou not already payed too deare, for thy knowing more than thy share? Or hast thou not heard, that who will pry into Majesty, shall be oppressed by the glory of it? Some are so curious (shall I say) or so ignorant, as to demand, what a humane soule will bee, after shee is delivered from her body; and unless they may see a picture of her, and have where by to fantasie her, they will not be perswaded, but that all are dreames, which our former discourses have concluded: as if hee, who findeth himselfe dazled with looking upon the Sun, had reason to complaine of that glorious body, and not of his own weak eyes, that can not entertaine so resplendent a light.

Wherefore to frame some conceit of a seperated soule, I will endeavour for their satisfaction, to say somewhat of her future state: Let us then first consider what a thought is, (I do not meane, that corporall spirit, which beateth at our common sense; but that

2.
That the soule is one simple knowing act which is a pure substance and nothing but substance.

which is within, in the inward soule, whose nature wee finde by discourse and effects, though wee cannot see it in it selfe.) To this purpose we may observe, that if we are to discourse, or to doe any thing, wee are guided the right way in that subject wee have in hand, by a multitude of particular thoughts; which are all of them terminated in that discourse or action: and consequently every act of our minde, is as it were an actuall rule or direction, for some part of such discourse or action: so that wee may conceive a compleate thought (compounded of many particular ones) to be a thiug, that ordereth on entire discourse or action of our life.

A thought being thus described, let us in the next place trye, if we can make an apprehension, what a *Science* or an *Art* is: as, what the *Science of Astronomy* is; or what the art of playing on the *Organs* is, when the *Astronomer* thinketh not of the motions of the Heavens, nor the *Organist* of playing on his instrument: which science and art, doe nevertheless even then reside in the *Astronomer*, and in the *Organist*: and we finde, that these are but the resultes of many former compleat thoughts; as being those very thoughts in remainder; whatsoever this may signifie.

Lastly, Let us conceive (if we can) a *power* or *capacity* to *being*: Vnto which capacity, if any *Being* be brought, that it is inseparably glewed and rivered unto it, by its very being a *being*: and if any two things bee brought unto it by the vertue of one *being*, common to both those things, that both of them, by this one *being* doe become one betwixt themselves, and with this *capacity*; and that so there is no end or period of this addition of things, by the mediation of *being*; but that by linkes and rings, all the things that are in the world, may hang together betwixt themselves, and to this power; if all of them may bee brought unto it by the Glew and vertue of *being*: in such sort as we have formerly declared, passeth in the Soule.

Now let us put this together, and make up such a thing, as groweth out of the capacity to *Being*, thus actuated and cleaving to all things that any way have *being*; and wee shall see, that it becommeth a whole entire world, ordered and clinging together with a great strength and necessity, as can proceed from the nature of *being*, and of *contradiction*: and our reason will tell us, that

that such a thing, if it be active, can frame a world, such an one as we live in, and are a small parcell of; if it have matter to worke upon; and can order whatsoever hath *Being*, any way that it is capable of being ordered, to do by it, and to make of it, whatsoever can be don by, and made of such matter.

All these conceptions (especially by the assistance of the last) may serve a litle to shadow out a perfect soule, which is, a *knowledge, an art, a rule, a direction, of all things*: and all this by being all things, in a degree & straine proper and peculiar to it selfe: & an imperfect soule, is a participation of this Idea: that is, a knowledge, a rule, and a direction, for as much as it is, and as it attaineth unto. Now as in our thoughts it is the corporeall part only which maketh a noise, and a shew outwardly, but the spirituall thought, is no otherwise perceived then in its effect, in ordering the bodily acts; in like sort, we must not conceive this knowledge to be a *motion*; but meereley to be a *thing* or *Being*, out of which the ordering and moving of other things doth flow; it selfe remaining fixed and immoveable; and because all that is joynd unto it, is there riveted by *Being*, or *identification*; and that when one thing is an other, the other is againe it; it is impossible that one should exceed the other, and be any thing that is not it: and therefore, in the soule there can be no parts, no accidents, no additions, no appendances, nothing that sticketh to it and is not it: but whatsoever, is in her is *soule*, and the soule, is all that which is within her; so that all that is of her, and all that belongeth unto her, is nothing but one pure simple substance, peradventure *Metaphysically*, or formerly divisible; (in such sort as we have explicated in the first Treatise, of the divisibility betweene quantity and substance) but not quantitatively, as bodies are divisible. In fine, substance it is, and nothing but substance; all that is in it, being joynd and impeded into it, by the very nature of *Being*, which maketh substance. This then, is the substantiall conceit of a humane soule stripped of her body.

Now, to conceive what proprieties this substance is furnished with; let us reflect upon the notions we frame of things, when we consider them in Common: as when we think of a man, of bread, of some particular vertue, of a vice, or of whatsoever else; and let us note, how in such, our discourse determineth no *place*, nor *time*; nay, if it should, it would marre the discourse; as Logicians shew, ² That a separated soule is in no place; and yet is not absent from any place, when

when they teach us, that scientificall syllogismes can not be made without universall propositions: so that we see, unles these things be stripped from *Place* and *Time*, they are not according to our meaning: and yet never the lesse, we give them both the name and the nature of a *Thing*, or of a *substance*, or of a *living Thing*, or of whatsoever else may by our manner of conceiving or endeavour, be freed from the subjection of *time* and *Place*. Thus then we plainly see, that it is a very different thing, *to be*, and *to be in a Place*: and therefore, out of a *Thinges being in no Place*, it can not be inferred, *That it is not*; or *that it is no substance*: nor contrariwise, out of *its being*, can it be inferred, *that it is in a Place*: there is no man but of himselfe perceiveth the false consequence of this argument, a thing *is*, therefore it *is hot*, or it *is cold*: and the reason is, because hot and cold, are particular accidents of a body; and therefore a body can be without either of them. The like proportion is betweene *Being* in generall, & *Being a Body*, or *Being in a Body*: for both these, are particulars in respect of *Being*: but *to be in a place*, is nothing else, but *to be in a circumstant Body*: and so what is not in a *Body*, is not in a *Place*: therefore, as it were an absurd illation, to say, *it is*, therefore it *is in a Body*; no lesse is it to say, *it is*, therefore it *is somewhere*; which is equivalent to, *in some Body*: and so a great Master (Peradventure one of the greatest, and judiciousst that ever have beene) telleth us plainly, that of it selfe it is evident, to those who are truly learned, that *incorporeall substances are not in Place*: and Aristotle teacheth us, *that the Vniverse is not in Place*.

But now to make use of this discourse, we must intimate what it is we dwell at in it: we direct it to two ends; first, to lead on our thoughts, and to helpe our apprehension, in framing some conception of a spirituall substance, without residence in *Place*, and to prevent our fancies checking at such abstraction; since we see that we use it in our ordinary speech, when we think not on it, nor labour for it, in all universall and indefinite termes: next to trace out an eminent propriety of a seperated soule: namely, that she is no where; and (yet upon the matter) that she is every where: that she is bound to no place, and yet remote from none: that she is able to worke upon all, without shifting from one to another, or comming neere any: and that she is free from all, without removing or passing from any one.

A second propriety; not much unlike the first, we shall discover in a separated soule, if we compare her with *time*. Wee have heretofore explicated, how *time* is the motion of the heavens; which giveth us our motion; which measureth all particular motions; and which comprehendeth all bodies, and maketh them awaite his leisure. From the large Empire of this proud Commander, a separated soule is free: For although shee doe consist with time, (that is to say, shee is, whiles time is;) yet is shee not in time; nor doth shee in any of her actions, expect time; but she is able to frame time, to spinne or weave it out of her selfe, and to master it.

3.
That a separated soule is not in time nor subject to it.

All which will appeare manifestly, if wee consider what it is to be in time. Aristotle sheweth us; that, to be comprehended under time, or to be in time, is, to be one of those moveables, whose being consisting in motion, taketh up but a part of time; and hath its termes, before, and behind, in time; and is measured by time; and must expect the flowing of Time, both for being, and for action. Now all this manifestly belongeth unto bodies, whose both action and being, is subject to a perpetuall locall motion and alteration: and consequently, a separated soule, who is totally a being, and hath her whole operation all together (as being nothing but her selfe when we speake of her perfective operation;) can not be said to be in time, but is absolutely free from it; though time doe glide by her, as it doth by other things: and so, all that she knoweth or can doe, she doeth and knoweth at once, with one act of the understanding, or rather, She is, (indeed and really) all that: and therefore shee doth not require time to manage, or order her thoughts, nor doe they succeed one an other, by such vicissitudes as men are forced to thinke of things by, because their fancies, and the Images in it which beate upon the soule to make her thinke, whiles she is in the body, are corporall, and therefore doe requite time to move in, and to give way to one and other: but shee thinketh of all the things in the world, and of all that shee can thinke of, together and at once; as hereafter we intend to shew.

A third propriety we may conceive to be in a separated soule; by apprehending her to bee an Activity; which that wee may rightly understand, let us compare her, in regard of working, with a body: reflecting then upon the nature of bodies, we shall find,

4.
That the soule is an active substance and all in it is active.

that

that not any of them will doe the functions they are framed for, unlesse some other thing doe stirre them up, and cause them so to doe. As for example; a knife, if it be thrust or pressed, will cut, otherwise, it will lye still and have no effect: and as it fareth with a knife, so it doth in the same manner with those bodies, which seeme most to move themselves; as upon a little consideration, will appeare plainly. A beast seemeth to move it selfe: but if we call to mind, what we have delvered upon this subject in the first Treatise, wee shall finde that whensoever he beginneth to move, he either perceiveth something by his sense, which causeth his motion, or else he remembreth something that is in his braine, which worketh the like effect. Now if sense presenteth him an object that causeth his morion, we see manifestly, that it is an externall cause which maketh him move: but if memory doe it, wee shall find that stirred by some other part; as by the stomach, or by the heart, which is empty, or heated, or hath received some other impression from an other body; so that, sooner or latter, we shall discover an outward mover. The like is in naturall motions; as, in heavy things, their easie following (if they bee sucked) an other way then downwards, testifiyeth that their motion downwards hath an extrinsecall motor, as is before declared: and not only in these, but throughout, in all other corporall things. So that in a word, all bodies are of this nature, that unlesse some other thing presse them and alter them, when they are quiet, they remaine so; and have no activity, otherwise then from an extrinsecall mover: but of the soule, we have declared the contrary; and that, by its nature, motion may proceed from jr, without any mutation in it, or without its receiving any order, direction, or impulse, from an extrinsecall cause.

5.
 A Description
 of the Soule.

So that, now summing up together, all we have said upon this occasion, we finde a soule exempted from the body, to be; *An indivisible substance, exempted from place and time, yet present to both: an actuall and present knowledge of all things that may be knowne: and a skill or rule, even by what it selfe is, to all things whatsoever.* This she is, if she be perfect: but if she be imperfect; then, is she all this to the proportion of her growth, (if so I may say) and shee is powerfull according to the measure of her knowledge, and of her will. So that in fine, a separated soule, is of a nature to have, and to know, and to governe all things.

I may reasonably suspect, that my saying how imperfect soules are rules to the proportion of their growth, may have occasioned great reflection, and may have bred some trouble in the curious and heedfull Reader. I confesse this expression was delivered by me, only to free my selfe for the present from the labour of shewing what knowledge every seperated soule hath: but upon second thoughts, I find that such sliding over this difficult point will not serve my turne, nor save me the paines of untying this knot: for unlesse I explicate what I meane by that speech, I shall leave my Reader in great doubt and anxiety; which to free him from, I must wade a little further in this question of the extent of a seperated soules knowledge, into which, I have thus, upon the by, engaged my selfe: but let him first be advertised, that I doe not here meddle, with what a seperated soule may know by revelation, or by supernaturall meanes: but that I doe only tracke out her naturall paths; and doe guesse at what she is, or knoweth, by that light which her conversation in her body affordeth us.

6.
That a separated soule knoweth all that which she knew whilst she was in her body.

Our entrance into this matter must be, to consider what mutation in respect of knowledge, a soules first change out of her body, maketh in her; for it is not unlikely, but that nature may some way enlighten us so farre, as to let us understand what must follow out of the negation of the bodies consortship, added unto what we know of her and other works in this world. This then first occurreth that surely she can not choose but stil know in that state, all that she did know whiles she was in the body; since we are certain that the body hath no part in that which is true knowledge: as is above declared, when we shewed; first, that all true knowledge is respective; secondly, that the first impressions of the fancie, doe not reach to the interiour soule, and lastly, that she worketh by much more, then what hath any actuall correspondence in the fancie, and that all things are united to her by the force of Being: from which last, it followeth that all things she knoweth, are her selfe; and she, is, all that she knoweth: wherefore, if shee keepeth her selfe and her owne being, shee must needs keepe the knowledge of all that she knew in this world.

Next

7. That the least knowledge which the soul acquirith in her body of any one thing doth cause in her, when shee is seperated from her body a compleat knowledge of all things whatsoever.

Next, she must undoubtedly know then somewhat more, then she knew in the body; for seeing that out of the things shee already knoweth, others will follow by the meer ordering and connexion of them; and that the soules proper worke, is to order things: we can not doubt, but that, both the things she knoweth in this world, must of necessity bee ordered in her to the best advantage; and likewise, that all that will be knowne, which wanteth no other cause for the knowing of it, but the ordering of these things: For if the nature of a thing, were *Order*, who can doubt but what were put into that thing, were put into *Order*? Now, that the nature of the soule is such, we collect easily; for seeing that all order proceedeth from her, it must bee acknowledged that *Order* is first in her: but what is in her, is her nature, her nature then is *Order*, and what is in her is ordered. In saying of which, I doe not meane that there is such an order betweene the notions of a seperated soule, as is betweene materiall things that are ordered by the soule whiles she is in the body; for seeing that the soule adequate cause of such order; (that is to say, a cause which can make any an such, and the whole kinde of it;) it followeth, that such order is not in her; for if it were, she would be cause of herselfe, or of her owne parts. *Order* therefore, in her, must signifie a thing more eminent, then such inferiour order, in which resideth the power of making that inferiour *Order*: and this is nothing else, but the connexion of her notions by the necessity of *being*; which we have often explicated. And out of this eminent or superiour kinde of order, our conclusion followeth no lesse then if the inferiour order which wee see in our fantasies, whiles our soule is in our body, did reside in our interiour soule; for, it is the necessity of identification, which doth the effect, and maketh the soule know; and the order of fantasmes, is but a precedent condition in the bodily Agent, that it may work upon the soule; and if more fantasmes then one could be together, this *order* would not be necessary.

Out of this, a notable and a vast conclusion manifestly followeth: to wit, that if a soule, can know any one thing more when shee is out the *body*, then what shee did know whiles shee was in the body; without any manner of doubt, shee knoweth all that can

bee drawne, and forced out of those knowledges, vvhich shee had in her body, How much this is, and how farre it will reach, I am afraid to speake: only I entreate Mathematicians, and such as are acquainted with the manner how sciences proceed; to consider how some of their definitions are made: to vvit by composing together sundry knowne termes, and giving a new name to the compound that resulteth out of them: wherefore cleare it is, that out of fewer notions had at the first, the soule can make many more and the more shee hath, or maketh, the more shee can multiply. Againe; the maximies, which are necessary to be added unto the definitions for gaining of knowledge, wee see are also compounded of ordinary and knowne termes; so that a separated soule, can want neither the Definitions, nor the Maximies, out of which the bookes of sciences are composed: and therefore, neither can the sciences themselves be wanting unto her. Now if wee consider, that in the same fashion as demonstrations are made, and knowledge is acquired in one science, by the same meanes, there is a transcendence from science to science: and that there is a connexion among all the sciences, which fall into the consideration of man, and indeed among all, at the least corporall things; (for of spirituall things, wee can not so assuredly affirme it; although their perfection may perswade us, that there is rather a greater connexion among them, then among corporall things) it will follow, that a soule vvhich hath but any indifferent knowledge in this vvorlde, shall be replenished with all knowlde in the next.

But how much is this indifferent knowlde, that for this purpose is required in this vvorlde? Vpon mature consideration of this point, it is true, I finde it absolutely necessary, that the soule must have here so much knowlde, as to bee able to determine that some one thing, vvhich hath connexion vwith all the rest, is in such a time: but then, vwhy out of this very conception, she should not bee able to clymbe up by degrees, to the knowledge of all other things vvhatsoever (since there is a connexion between that, and all the rest, and no untransible gappe, or Chaos to sever them) I professe I doe not see. Which if it bee so, then the soule of an abortive in his mothers Wombe, if hee once arrive to have sense, and from it, to receive any impression in his soule, may for
ought

ought I know, or can suspect to the contrary, be endued in the next world with as much knowledge, as the soule of the greatest Clerke that ever lived: and if an abortive do not arrive so farre, as to the knowledge of some one thing, I know no reason, why we should beleve it arrived to the nature of man.

Whence it followeth, that this amplitude of knowledge, is common to all humane soules, (of what pitch soever they seeme to be here) when they are separated from their bodies: as also, that if any error have crept into a mans judgement, during this life, whether it be of some universall conclusion, or of some particular thing, all such will be abolished then, by the truth appearing on the opposite side; so hence two contradictory judgements, can not possesse our soule together: as even in this world, as well experience, as reason teacheth us.

8
An answer to
the objections
of some Peri-
patetikes who
maintaine the
soule to perish
with the body.

But unawares I have engulfed my selfe into a sea of contradiction, from no meane adversaries: for Alexander, Aphrodisens, Pomponatius and the learnedest of the Peripatetike schoole, will all of them rise up in maine opposition against this doctrine of mine: shewing how in the body, all our soules knowledge is made, by the working of our fantasie; and that there is no act of our soule, without speculation of fantasmes residing in our memory: therefore, seeing that when our body is gone, all those little bodies of fantasmes are gone with it; what signe is there, that any operation can remaine? And hence they inferre, that seeing every substance hath its *Being* for its operations sake, and by consequence were vaine and superfluous in the world, if it could not enjoy, and exercise its operation; there is no necessity or end, why the soule of a man should survive his body: and consequently, there is no reason to imagine other, then that it perisheth when the man dieth. This is the substance of their Argument; which indeed is nothing else, but to guesse without ground, or rather against all ground: but howsoever, this comfort I have, that I have to doe with Peripatetikes; men that will heare and answer reason: and to such I addressse my speech.

To joyne issue then with them, and to encounter them with their owne weapons, let us call to minde, what Aristotle holdeth light to be. He saith, that it is a suddaine and momentary *em-
nation*

nation of what it is, following the precedent motion of some body, but without motion in it selfe. As for example: when the Sunne commeth into our horison, (saith he) the illumination of the Horison, is an effect in an instant, following from the motion which the Sunne had, since his setting in the other Hemisphere, untill hee appeare there againe: so that (according to him) the way of making this light, is the Sunnes locall motion; but the effect or *the being enlightened*, is a thing of a very different nature, done without beginning, and continuing untill the Sunne depart againe from our Horison. And as hee explicateth this action of illumination, in the same manner, doth hee the actions of sense and of understanding. Vpon all which I urge, that no Peripatetike will deny mee, but that as in every particular sensation or thinking, there proceedeth a Corporall motion, out of vvhich it ensueth, so this generall motion, which wee call *the life of man*, proceedeth that twinkle or moment, in which shee becommeth an absolute spirit, or inhabitant of the next world. Wherefore it cannot bee said, that wee introduce a doctrine aliene from the Peripatetike way of Philosophising, if wee put a momentary effect or motion (according to their phrase of speaking) to follow out of the course of mans life; since they put diverse such effects, to follow out of particular parts of it.

Now, this momentary change, or what they please to call it, is that which maketh at one blow, all this knowledge we speake of: for, if we remember that knowledge is not a *doing* or a *motion*, but a *Being*; as is agreed betweene the Peripatetikes and us; they cannot, for the continuing it, require instruments and motors: for they are necessary onely for change, not for *being*. Now, all this mighty change, which is made at the soules delivery, vve conceive followeth precisely out of the change of her *Being*: for seeing it is supposed, that her *Being* vvas be ore in a body, but is now out of a body; it must of necessity follow, that all impediments, which grevv out of her being in a body, must bee taken away by her being freed from it. Among which impediments, one is, that time is then required betwixt her

knowledge of one thing, and her knowledge of another thing; and so her capacity, that of it selfe is infinite, becometh confined to that small multitude of objects, which the division and straightnesse of time giveth way unto. Now that, which length of time could in part worke in the body, the same is entirely done in a moment, by the changing of her manner of *being*: for by taking away the bondes, by which she was enthralled in the body, & was kept in, to apprehend but according to the measure of the body, and was constrained to be, and to enjoy her selfe (as it were) but at the bodies permission; she is put in free possession of her selfe, and of all that is in her. And this is nothing else, but to have that large knowledge, wee have spoken of, for her knowing all that, is no other thing but her being her selfe perfectly. Which will appeare evident, if we consider that her nature is, *to bee a Knower*, and that Knowledge is nothing else but a *Being of the object in the Knower*; for thence it followeth, that to know all things is naught else then to bee all things: since then, wee concluded by our former discourse, that all things were to bee gathered out of any one; it is cleare that to be perfectly her selfe, and any one thing, is in truth to know all things.

And thus wee see, that for the soules enjoying all this knowledge when shee is out of the body, shee needeth no objects without her, no phantasmes, no instruments, no helps; but that all that is requisite, is contained absolutely in her being her selfe perfectly. And so wee retort our Adversaries Objection on themselves; by representing to them, that since in their owne doctrine, they require no body nor instruments, for that precise action which they call understanding: it is without all ground, for them to require bodies and instruments in the next life, that the soule may there be that, which; they acknowledge shee is in her body without any such helps.

And as for that *Axiome* or experience, *that the Soule doth not understand, unlesse shee speculate phantasmes*: as on the one side I yeeld to it, and confesse the experience, after the best and seriousst tryall I could make of it; so on the other side,

side, when I examine the matter to the bottome, I find that it commeth not home to our adversaries intention. For as when we looke upon a thing, we conceive we worke upon that thing, whereas in truth we do but set our selves in such a position that the thing scene may worke upon us: in like manner our looking upon the phantasmes in our braine; is not our soules action upon them, but it is our letting them beat at our common sense; that is, our letting them worke upon our soule. The effect whereof is that either our soule is bettered in her selfe; as when we study and contemplate: or else, that she bettereth something without us, as when by this thinking, we order any action.

But, if they will have this *Axiome* awayle them, they should shew that the soule is not of her selfe a knowledge; which if they be able to do, even then when to our thinking, she seemeth not so much as to thinke, we will yeeld they have reason: but that will be impossible to them to do; for she is alwayes, of her selfe, a knowledge, though in the body she never expresseth so much, but when she is put to it. Or else they should shew, that this knowledge which the soule is of her selfe, will not by changing the manner of her *Existence*, become an actuall knowledge, instead of the habituall knowledge which now appeareth in her.

But as these Aristotelians embrace and sticke to one *Axiome* of their Patrone; so they foregoe and prevaricate against another: for as it is Aristotles doctrine, that a substance is for its operation, and were in vaine and superfluous if it could not practise it; so likewise it is confessed doctrine, that *Matter* is for its *forme* and not the *forme* for the *matter*. And yet these men pretend that the soule, serveth for nothing but the governing of the body: whereas contrariwise, both all Aristotles doctrine, and common sense convinceth, that the body mu't be for the soule. Which if it be, nothing can be more consentaneous to Reason, then to conceive that the durance which the soule hath in the body, is assigned her to worke and mould in her the future state, which she is to have after this life: and that no more operations are to be expected from her

9.
The former Peripateticke refused out of Aristotle.

after this life, but instead of them, a settled state of *Being*, seeing that, even in this life, according to Arist. doctrine, the proper operations of the soule are but certaine *Beings*: so that we may conclude, that if a soule were growne to the perfection, which her nature is capable of, she would be nothing else but a constant *Being* never changing from the happinesse of the best *Being*.

And although the texts of Aristotle which remaine unto us, be uncertaine (peradventure, not so much because they were originally such, in themselves, as through the mingling of some comments into the body of the text;) yet if we had his booke which he wrote of the soule upon the death of his freind Eudemus, it is very likely we should there see his evident assertion of her *Immortality*; since it had bene very impertinent to take occasion upon a friends death to write of the soule, if he intended to conclude, that of a dead man there were no soule.

To.
The operations of
a separated Soule
compared to her
operations in her
body.

Out of this discourse it appeareth how those Actions which we exercise in this life, are to be understood, when we heare them attributed to the next: for to thinke that they are to be taken in their direct plaine meaning, and in that way, in which they are performed in this world; were a great simplicity, and were to imagine a likenesse betweene bodies and spirits, we must therefore elevate our mindes, when we would penetrate into the true meaning of such expressions, and consider how all the actions of our soule are eminently comprehended in the universality of knowledge, we have already explicated. And so, the Apprehensions, judgements, discourses, reflections, talkings together, and all other such actions of ours, when they are attributed to separated soules, are but inadequate names and representations of their instantaneall sight of all things, for, in that, they can not choose but see others mindes, which is that we call talking, and likewise their owne, which we call reflection: the rest are plaine partes, and are plainely contained in knowledge; discourse being but the falling into it; judgement the principles of it; and single apprehensions the components of judgements.

then

then for such actions as are the beginning of operation, there can bee no doubt but that they are likewise to be found, and are resumed, in the same Vniversality; as, love of good, consultation, resolution, prudentiall election, and the first motion; for who knoweth all things, can not choose but know what is good, and that good, is to bee prosecuted: and who seeth compleatly al the meanes of effecting & attaining to his intended good; hath already consulted & resolved of the best: & who understandeth perfectly the matter he is to work upon, hath already made his prudential election: so that there remaineth nothing more to be don but to give the first impulse.

And thus you see, that this universality of knowledge in the soule, comprehendeth all, is all, performeth all; and no imaginable good or happinesse, is out of her reach. A noble creature, and not to be cast away upon such trash as most men employ their thoughts in. Vpon whom it is now time to reflect; and to consider, what effects the divers manners of living in this world, do work upon her in the next; if first wee acquit our selves of a promise wee made at the end of the last Chapter. For it being now amply declared, that the state of a Soule exempted from her body, is a state of pure *being*; it followeth manifestly, that there is neither action nor passion in that state: which being so, it is beyond all opposition that the soule can not dye: for it is evident that all corruption, must come from the action of an other thing, upon that which is corrupted; and therefore that thing must be capable of *being* made better and of being made worse. Now then, if a separated soule be in a finall state, where she can neither bee bettered, or worsened, (as she must be, if she be such a thing, as we have declared) it followeth that shee can not possibly loose the *Being* which she hath: and sithence her passage out of the body, doth not change her nature, but only her state; it is cleare, that she is of the same nature even in the body: though in this her duration, she be subject to be forged (as it were) by the hammers of corporeall objects beating upon her; yet so, that of her selfe she still is what she is. And therefore as soone as she is out of the passible oore, in which shee suffereth by reason of that oore, shee presently becommeth impassible, as *being* purely of

her owne nature, a fixed substance, that is, a pure *being*. Both which states of the soule, may in some sort be adumbrated by what we see passeth in the coppelling of a fixed metall; for as long as any lead, or drosse, or allay remaineth with it, it continueth melted, flowing, and in motion under the muffle: but as soone as they are parted from it, and that it is become pure, without any mixture, and singly it selfe; it contracteth it selfe to a narrower roome, and at that very instant, ceaseth from all motion, groweth hard, permanent, resistant unto all operations of fire, and suffereth no change or diminution in its substance by any outward violence we can use unto it.

CHAP. XI.

Shewing what effects, the divers manners of living in this world, doe cause in a soule, after she is separated from her body.

^{1.}
That a soule in this life is subject to mutation, and may be perfected in knowledge.

ONe thing may peradventure seeme of hard digestion in our past discourse; and it is, that out of the grounds wee have laid, it seemeth to follow that all soules will have an equality; since we have concluded, that the greatest shall see or know no more than the least: and indeed, there appeareth no cause why this great and noble creature, should be imprisoned in the obscure dungeon of roysome flesh; if in the first instant, in which it hath its first knowledge it hath then already gained all what soever it is capable of gaining in the whole progresse of a long life afterwards. Truly, the Platonike Philosophers (who are perswaded that a human soule doth not profit in this life, nor that she acquires any knowledg here; as being of her selfe compleately perfect, and that all our discourses, are but her remembrings of what she had forgotten) will find themselves ill bested to render a Philosophicall and sufficient cause of her being locked into a body: for to put forgetfulness in a pure spirit; so palpable an effect of corporeity, and so great a corruption, in respect of a creature whose nature is, to know of it selfe, is an unsufferable error. Besides, when they tell us, that shee can not be changed, because all change would prejudice the spirituall nature, which they attribute to her; but that well she may be warned and excited by being in a body;

body; they meely trifle: for either there is some true mutation made in her by that which they call a warning, or there is not; if there be not, how becommeth it a warding to her? Or what is it more to her then if a saw were wagged at the Antipedes? But if there be some mutation (be it never so little) made in her by a corporeall motion; what should hinder, why she may not by means of her body, attaine unto science she never had; as well as by it receive any the least intrinsecall mutation whatsoever? For if once we admit any mutability in her from any corporeall motion it is far more conformable unto reason to suppose it in regard of that which is her naturall perfection, & of that, which by her operations wee see she hath immediately after such corporeall motions, and wherof before them there appeared in her no marks at all; then to suppose it in regard of a dark intimation, of wch we neither know, it is not how it is performed. Surely, no Rationall Philosopher seeing a thing, whose nature is to know, have a being, wher eas formerly it existed not; & observing, how that thing by little and little giveth signes of more and more knowle'ge, can doubt but that as she could be changed from not being to being; so, may shee likewise bee changed from lesse knowing, to more knowing.

This then being irrefragably settled, that in the body she doth encrease in knowledge: let us come to our difficulty & examine what this encrease in the body availeth her; seeing that as soone as she parteth from it, she shall of her own nature enjoy, and be replenished with the knowledge of all things: why should she laboriously strive to anticipate the getting of a few drops which but encrease her thirst and anxiety; when having but a little patience, she shall at one full and everlasting draught drink up the whole sea of it? We know that the soule is a thing, made proportionably to the making of its body; seeing, it is the bodies compartner: and wee have concluded, that whiles it is in the body, it acquireth perfection in that way, which the nature of it is capable of: that is, in knowledge: as the body acquireth perfection its way; which is, in strength and agility. Now then let us compare the proceedings of the one, with those of the other substance; and peradventure wee may gaine some light to discern what a dyantage it may prove unto a soul, to remain long

2.
That the knowledges which a soul getteth in this life will make her knowledge in the next life more perfect and firme.

in its body; if it make right use of its dwelling there. Let us consider the body of a man, well and exactly shaped in all his members; yet if he never use care nor pains to exercise those well framed limbes of his; he will want much of those corporeall perfections which others will have, who employ them sedulously. Though his legges, armes, and handes, be of an exact symmetry; yet he will not be able to runne, to wrestle, or to throw a dart, with those who labour to perfect themselves in such exercises: though his fingers be never so neatly moulded or composed to all advantages of quick and smart motion; yet if he never learned and practised on the lute, he will not be able with them to make any musike upon that instrument, even after he seeth plainly, and comprehendeth fully all that the cunningest Lutenist doth; neither will he be able to play, as he doth with his fingers, which of themselves are peradventure les apt or those voluble motions then his are. That which maketh a man dexterous in any of these arts, or in any other operations, proper to any of the partes or limbes of his body, is the often repetitions of the same Acts; which do amend and perfect those limbes in their motions, and which make them fit & ready for the actions they are designed unto.

In the same manner it fareth with the soule; whose essence is that which she knoweth: her severall knowledges may be compared, to armes, hands, fingers, legges, thighs &c. in a body: and all her knowledges taken together, do compose (as I may say) and make her up, what she is. Now, those limbes of hers, though they be, when they are at the worst, entire, and well shaped in bulke (to use the comparison of bodies,) yet they are susceptible of further perfection, as our corporeall limbes are, by often and orderly use of them. When we iterate our acts of our understanding any object, the second act is of the same nature, as the first, the third as the second, and so, of the rest: every one of which perfecteth the understanding of that thing, and of all that dependeth upon the knowledge of it, and maketh it become more vigorous and strong; even the often throwng of a boule at the same marke, begetteth still more and more strength and justnesse in the Arme that delivereth it: for, it can not be denyed

but that the same cause which maketh any thing, must of necessity perfect and strengthen it, by repeating its force and strokes. We may then conclude that the knowledge of our soule, (which is indeed her selfe) will be in the next life more perfect and strong, or, more flake and weak, according as in this life she hath often and vigorously, or faintly and seldome, busied her selfe about those things which beget such knowledge.

Now those things which men bestow their paines to know, we see are of two kindes: for some thirst after the knowledge of nature, and of the variety of things, which either their senses, or their discourse, tell them of: but others looke no higher then to have an insight into humane action, or to gain skill in some art, whereby they may acquire meanes to live. These latter curiosities, are but of particulars; that is, of some one, or few species, or kindes, whose common that comprehendeth them, falleth within the reach of every vulgar capacity; and consequently, the things which depend upon them, are low, meane, and contemptible: whereas the beauty, vastnesse, and excellency of the others, is so much beyond them, as they can be brought into no proportion to one another. Now then, if we consider, what advantage the one sort of these men, will in the next world have over the other; we shall find, that they who spend their life here in the study and contemplation of the first noble objects; will, in the next, have their universall knowledge (that is their soule) strong and perfect: whiles the others, that played away their thoughts and time upon trifles, and seldome raised their mindes above the pitch of sense, will be faint through their former lazinesse, like bodies benumbed with the palsey, and sickely through their ill dyet, as when a well shaped virgin, that having sed upon trash instead of nourishing meates languisheth under a wearisome burthen of the greene sicknesse.

To make this point yet more cleare, we may consider how the things which we gaine knowledge of, do affect us under the title of good and convenient, in two severall manners. The one is, when the appearance of good, in the abstracted nature of it, & after examination of all circumstances, carryeth

³ That the soules of men addicted to science whilst they lived here are more perfect in the next world then the soules of unlearned men.

⁴ That those soules which embrace vertue in this world will be most perfect in the next, and those which embrace vice most miserable.

our heart to the desire of the thing, that appeareth to unto us: the other is, when the semblance of good to our owne particular persons without casting any further, or questioning whether any other regard may not make it prejudiciall, doth cause, in us a longing for the thing wherein such semblance shineth. Now for the most part the knowledges which spring out of the latter objects, are more cultivated by us: then those which arise out of the other; partly by reason of their frequent occurring, either through necessity, or through judgement; and partly, by the addition which passion giveth to the impressions they make upon us: for passion multiplieth the thoughts of such things, more then, of any others, if reason do not crosse and suppress her tumultuary motions, which in most men, she doth not. The soules then of such persons, as giving way to their passion, do in this life busie themselves about such things as appeare good to their owne persons, and cast no further, must needes decede from their bodys, unequally builded. (if that expression may be permitted me;) and will bee like a lame unwieldy body, in which the principall limbes, are not able to governe and move the others, because those principall ones are faine, through want of spirits and exercise; and the others are overgrowne with hidropicall and nocive humours. The reason whereof is that in such soules their judgements will be disproportioned to one another, one of them being unduely stronger then the other. What effect this worketh, in regard of knowledge, we have already declared, and no lesse will it have in respect of action: for suppose two judgements to be unequal, and such, as in the action one contradicteth the other, for example, let one of my judgements be, that it is good for me to eate because I am hungry; and let the other be, that it is good for me to study, because I am shortly to give an account of my selfe, if the one judgment be stronger then the other, as if that of eating be stronger then that of studying, it importeth not that there be more reason (all circumstances considered) for studying: because, reasons, do move to action according to the measure in which the resolution that is taken upon them, is strong or weake; and therefore, my action will follow the strongest

strongest judgment, and I shall leave my booke to go to my dinner.

Now, to apply this to the state of a seperated soule; we are to remember how the spirituall judgements, which she collected in the body, do remaine in her after she is divetted of it: and likewise, we are to consider, how all her proceeding in that state, is built, not upon passion, or any bodily causes or dispositions; but meerey upon the quality and force of those spirituall judgments: and then, it evidently followeth, that if there were any such action in the next life, the pure soule would apply it selfe thereunto, according to the proportion of her judgements, and as they are graduated and qualified. It is true; there is no such action remaining in the next life; yet neverthelesse there remaineth in the soule a disposition and a promptitude to such action; and if we will frame a right apprehension of a seperated soule, we must conceit her to be of such a nature (for then all is nature with her, as hereafter we shall discourse) as if she were a thing made for action in that proportion and efficacy, which the quartering of her by this variety of judgements doth afford; that is that she is, so much the more fit for one action then for another, (were she to proceed to action); as the judgment of the goodnesse of one of these actions is stronger in her, then the judgment of the others goodnesse, which is in effect, by how much the one is more cultivated then the other. And out of this we may conclude, that what motions do follow in a man, out of discourse, the like will in a seperated soule, follow out of her spirituall judgments. So that as he is joyed, if he do possesse his desired good; and is discontented and displeas'd, if he misse of it and seizeth greedily upon it when it is present to him, and then cleaveth fast unto it, and whiles he wanteth it, no other good affecteth him, but he is still longing after that Masse-wish of his heart: the like in every regard, but much more vehemently, befalleth unto a seperated soule. So that in fine she will be happy, or miserabell, according as she hath built up her selfe, by her spirituall judgments and affections in this life. If knowledge and intellectual objects be the goods she thirsteth after, what can be happier then she, when she possesseth the fullnesse:

fullnesse of all that can be desired in that kinde? But if in this world a man settleth his heart constantly upon any transitory end; as upon wealth corporeall delights, honour, power, and the like, (which are too short breathed attendants to follow him so long a journey as into the next;) then, all the powers of his soule, even after she hath left her body, will be still longing after that deare Idoll of her affections; and for the want of it, she will not value the great knowledge she shall then be imdued withall, nor care for any other good she possesseth, like a man who being forrouted, with a full sea and swolne tide of all specious objects that may please and delight him; hath by unluckly chance suffered his violent affections, and his impotent desires to be intrangled in some meane love, that either neglecteth him, or he is hindered from enjoying; and thereby, that little drope of gall, or rather that privation of a meane contentment (which truly in it selfe, is nothing) infecteth and poysoneth the whole draught of happinesse that but for this, would swell him up to the height of his wishes.

5.
The state of a vicious soule in the next life.

But no comparisons of sorrowes, griefes, or anguishes in this life (where our earthly dwelling doth so clog, and allay, and dull the sense of our soule, which only feeleth and relieth either delight or woe) can arrive to shalow out the misery of a separated soule so affected; whose straines are so excessively vehement, and whose nature is a pure activity, and her selfe, all sense, all knowledge. It is true, I confesse that in a man, such motions doe in part proceed from passion: and therefore, I will allow, that so much of them, as have their origine meerely and onely from thence, shall dye with the body, and shall not have made any impression in the separated soule: but besides the streame of passion wee may in such motions observe also, the work of reason, for she, both approveth and employeth her powers, to compassse and gaine what the other presenteth, & by legitimate discourse, draweth consequences out of that principle or judgment, which maketh the byas, it then leaneth unto: and these, are undeniable effects of a spirituall judgment settled in the soule. And therefore, as farre as these motions proceed from spirituall judgments, so far, it is cleare they must remaine in the separated soule.

paradventure

Peradventure, what I have said, may bee lyable to a mistake; as though I conceived that these spirituall judgments are made in the soule according to right reason, and to legitimat discourse: whereas, I meane nothing lesse; but esteeming an overstrong judgement in the seperated soule, to be proportionable unto a passion in the body; I conceite that as passion setreth reason on work to finde out meanes, whereby shee may arrive unto her ends; so in like manner, may this judgment set reason on floate, with those acts which follow consequently upon it (though inconsequent to the whole body of reason:) because the disorder there, is, in the excesse of this judgment over others, whose force (according to nature) ought to be greater than it. So that, if we would frame a conception of a disordered soule, when it is out of the body; wee may imagine it correspondent to a body, whose one part were bigger then could stand in proportion with an other, as, if the hand (to use the example wee brought before) were greater than the arme could manage, or the foote were larger and heavyer, then the leg and thigh could wield: unto which adde that every part were active and working of it selfe: so as, though it could not bee governed, yet would it continually have its owne operation, which would bee contrary to the operation of the arme, or of the legge, and consequently, it would ever bee tending to impossible operations: and by that meanes, both one member would alwayes disagree from the other, and neither of them attaine any effect at all; not unlike to the fanse of the Poets, who fained a monster, which they termed *Scylla*, whose inferiour parts, were a company of dogges, ever snarling and quarrailling among themselves; and yet were unseverable from one an other, as being compartes of the same substance.

But to declare this important doctrine more dogmatically; let us consider that of necessity a disordered soule hath these following judgments settled in her. Namely, that shee is not well; that shee cannot bee well without her desired good; that it is impossible for her to compasse that good; and lastly, that this state shee is in, is by all meanes possible to be avoyded; not, by changing her judgment (for that is her
selfe).

selfe) but by procuring the satisfaction she desireth; and this with all the power, and totall inclination of her activity and possibility. This then, being the temper of a disordered separated soule, it is easie to conceive, what a sad condition such an one remaineth then in; which is infinitely more, then any affliction that can happen to a man in this world: for since, even here, all our joyes and griefes, doe proceed from our soule; wee must needs allow, that when shee shall bee from the burthen of her body (which doth exceedingly impeach, and limit her operations, and activity) all her actions will be then farre greater and more efficacious.

6. *The fundamental reason why as well happinesse as misery is so excessive in the next life.*

But because this point is of highest consequence, wee may not slightly passe it over; but we will endeavour, if we can, to discover the wonderfull efficacy and force of a separated soules operations; that from thence wee may the better collect, how great her happinesse or misery will bee in the next life. Let us then consider, how an act or judgment of the soule, may bee more forcible, either by it selfe, or by the multiplication of such helpes, as doe concurre with it. To begin with considering the Act in it selfe, we know that the certaintest way to measure the strength of it, is to take a survey of the force which she veveth it selfe in its effect: for the being relatives to one another, each of them discovereth the others nature. Now, this vve vwill doe after our ordinary manner, by comparing the spirituall effects issuing from a judgement in the soule, to materiall effects proceeding from the operations and motions of bodies. In these we may observe three things, by vvhich we may estimate their efficaciousnesse: some actions dure a longer time; others, take up a greater place, and others againe, worke the like effect in a greater place, and in a shorter time: which last sort, of all others, do proceed from the most powerfull, and most forcible agents. If then in these considerations, we compare a separated soule to a body; what an infinity of strength & efficacy, will the meanest of those pure substances have, beyond the most powerfull and active body that can bee imagined in nature? For wee have already shewed how a separated soule comprehendeth at once, all place, and all times: so that, her activity requireth no application

cation to place or time ; but, she is, of her selfe, mistress of both, comprehending all quantity whatsoever, in an indivisible apprehension ; and ranking all the parts of motion, in their compleate order : and knowing at once, what is to happen in every one of them. On the other side ; an incorporated soule, by reason of her being confined to the use of her senses, can looke upon but one single definite place, or time, at once ; and needeth a long chaine of many discourses to comprehend all the circumstances of any one action : and yet after all, how short she is of comprehending all ? So that comparing the one of these with the other, it is evident, that in respect of time and place ; and in respect of any one singular action ; the proportion of a separated soule, to one in the body, is as all time, or all place, in respect of any one piece, or least parcell of them ; or as the entire absolute comprehender of all time and all place, is to the discoverer of a small measure of them. For whatsoever a soule willeth in that state, shee willeth it for the whole extent of her duration ; because she is then out of the state or capacity of changing : and wisheth for whatsoever she wisheth, as for her absolute good ; and therefore employeth the whole force of her judgment, upon every particular wish. Likewise the eminency which a separated soule hath over place, is also then entirely employed upon every particular wish of hers ; since in that state there is no variety of place left unto her, to wish for such good in one place, and to refuse it in an other ; as, whiles she is in the body hapneth to every thing she desireth. Wherefore, whatsoever she then wisheth for, she wisheth for it according to her comparison unto place : that is to say ; that as such a soule hath a power to worke at the same time in all place by the absolute comprehension, which she hath of place in abstract : so every wish of that soule if it were concerning a thing to be made in place, were able to make it in all places ; through the excessive force & efficacy wherewith she employeth upon every particular wish.

The third effect by which among bodyes we gather the vigour, and energy of the cause that produceth it, (to witte, the doing of the like action, in a lesser time and in a larger extent,) is but a combination of the two former : and therefore it requireth no further particular instance upon it, to shew, that likewise in this, the proportion of a separated to an incorporated soule

soule, must needs be the selfe same as in the others; seeing that a separated soules activity, is upon all place in an indivisible of time.

Therefore to shutt up this point; there remaineth only for us to consider, what addition may be made unto the efficacy of a judgement by the concurrence of other extrinsecall helps. We see that when an understanding man will settle any judgement, or conclusion in his minde, he weigheth throughly all that followeth out of such a judgement; and considereth likewise all the antecedents that lead him unto it: and if after due reflection, and examination, of whatsoever concerneth this conclusion which he is establishing in his mind, he findeth nothing to crosse it, but that every particular and circumstance goeth smoothly along withit, and strengtheneth it; he is then satisfied, and quiet in his thoughts, and yeeldeth a full assent thereunto: which assent is the stronger, by how many the more concurrent testimonies he hath for it. And although he should have a perfect demonstration or sight of the thing in it selfe, yet every one of the other extrinsecall proofes, being as it were a new perswasion, hath in it a further vigour to strengthen and content his mind in the forehad demonstration: for, if every one of these be in it selfe sufficient to make the thing evident; it can not happen that any one of them, should hinder the others: but contrariwise, every one of them must needs concurre with all the rest, to the effectuall quieting of his understanding, in its assent, to that judgement. Now then, according to this rate, let us calculate, (if we can) what concurrence of proofes and witnesses a separated soule will have to settle and strengthen her in every one of her judgements. We know, that all verities are chained and connected one to another; and that there is no true conclusion so far remote from any other, but may by more, or lesse consequences and discourses, be deduced evidently out of it: it followeth then that in the abstracted soule, where all such consequences are ready drawne, and scene in themselves without exteption of time or employing of paines to collect them; every particular verity, beareth testimony to any other, so that every one of them is beleaved, and workerh in the sence and verue of all. Out of which it is manifest, that every judgement in such a separated soule, hath an infinit strength and effecacy over any, made by an embodied one. To

To summe all up in a few words: we finde three rootes of infinity in every action of a separated soule, in respect of one in the body: first, the freedome of her essence or substance in it selfe: next, that quality of hers, by which she comprehendeth place and time; that is, all permanent and successive quantity: and lastly, the concurrence of infinite knowledges to every action of hers. Having then this measure in our hands, let us apply it to a well ordered, and to a disordered soule passing out of this world: let us consider the one of them, set upon those goods, which shee shall there have present, and shall fully enjoy: the other, languishing after, and pining away for those, which are impossible for her ever to obtaine. What joy, what content, what exultation of mind, in any living man, can be conceived so great, as to be compared with the happinesse of one of these soules? And what grieffe, what discontent, what misery can be like the others?

These are the different effects, which the divers manners of living in this world, doe cause in soules after they are delivered from their bodies: out of which, and out of the discourse that hath discovered these effects unto us, we see a cleare resolution of that so maine and agitated question among the Philosophers, why a ratioll soule is imprisoned in a grosse body of flesh and bloud? In truth, the question is an illegitimate one; as supposing a false ground: for the soules being in the body, is not an imprisonment of a thing that was existent, before the soule and body met together; but her being there, is the naturall course of beginning that, which can no other way come into the lists of nature: for should a soule, by the course of nature, obtaine her first beeing without a body, eyther she would in the first instant of her being, be perfect in knowledge, or she would not: if she were, then would she be a perfect and compleat immateriall substance, not a soule; whose nature is to bee a partner to the body, and to acquire her perfection by the mediation and service of corporeall senses: but if shee were not perfect in science, but were only a capacity thereunto, and like unto white paper, in which nothing were yet written; then unlesse shee were put into a body she could never arrive to know any thing, because motion and alteration are effects peculiar to bodies: therefore, it must be agreed, that she is naturally designed to be in a body: but her being in a body, is her being one thing with the body, she is said to

7.
The reason why mans soule requireth to bee in a body, and to live for some space of time joyned with it.

be in : and so she is one part of a whole, which from its weaker part is determined to be a body.

Againe, seeing that the matter of any thing, is to bee prepared, before the end is prepared, for which that matter is to serve ; according to that Axiome. *Quod est primum in intentione, est ultimum in executione* : we may not deny, but that the body is in being, some time before the soule : or at the least, that it existeth as soone as she doth : and therefore, it appeareth wholly unreasonable, to say, that the soule was first made out of the body, and was afterwards thrust into it ; seeing that the body was prepared for the soule before, or at the least, as soone as she had any beginning : and so we may conclude, that of necessity the soule must be begunne, layed, hatched, and perfected in the body.

And although it bee true, that such soules, as are seperated from their bodies, in the first instant of their being there, are notwithstanding imbued with the knowledge of all things ; yet is not their longer abode there in vaine : not onely, because thereby the species is multiplied ; (for nature is not content with barely doing that, without addition of some good to the soule it selfe) but as we for the wonderfull, and I may say infinite advantage, that may thereby accrew to the soule, if she make right use of it : for, as any act of the abstracted soule is infinit, in comparison of the acts which men exercise in this life, (according to what we have already shewed) so by consequence, must any increase of it, be likewise infinite : and therefore we may conclude, that a long life well spent, is the greatest and most excellent gift, which nature can bestow upon a man.

8.

That the misery of the soule in the next world, proceedeth out of inequality, and not of falsity of her judgements.

The unwary reader may perhapps have difficulty, at our often repeating of the infelicity of a miserable soule ; since wee say, that it proceedeth out of the judgements, shee had formerly made in this life ; which without all doubt were false ones : and neverthelesse, it is evident, that no false judgements, can remaine in a soule, after she is seperated from her body ; as we have above determined. How then can a soules judgements, be the cause of her misery ? But the more heedfull reader, will have noted, that the misery which wee put in a soule, proceedeth out of the inequality, not out of the falsity, of her judgements : for if a man bee inclined to a lesser good, more then to a greater, he will in action betake himselfe to the lesser good.

good, and desert the greater, (wherein, neither judgement it false, nor either inclination is naught) niereely out of the impropotion of the two inclinations or judgements to their objects: for that a soule may be duely ordered, and in a state of being well, shee must have a lesser inclination to a lesser good, and a greater inclination to a greater good: and in pure spirits, these inclinations are nothing else, but the strength of their judgements: which judgements in soules, whiles they are in their bodies, are made by the repetition of more acts from stronger causes, or in more favourable circumstances. And so it appeareth, how without any falsity in any judgement, a soule may become miserable, by her conversation in this world; where all her inclinations generally are good, unlesse the disproportion of them, do make them bad.

THE TWELFTH CHAPTER.

Of the perseverance of a soule, in the state shee findeth her selfe in, at her first separation from her body.

THUS wee have brought mans soule, out of the body she lived in here, and by which she conversed, and had commerce with the other parts of this world: and we have assigned her, her first array and stole, with which she may be scene in the next world: so that now there remaineth onely for us to consider, what shall betide her afterwards; and whether any change may happen to her, and be made in her, after the first instant of her being a pure spirit, separated from all consortshippe with materiall substances. To determine this point the more clearly, let us call to minde, an axiome that Aristotle giveth us in his logicke; which teacheth us. *That as it is true, if the effect be, there is a cause; so likewise it is most true, that if the cause be in act, or causing, the effect must also be.* Which *Axiome* may be understood two waies: the one, that if the cause hath its effect, then the effect also is: and this is no great mistery; or for it, are any thanks due to the teacher; it being but a repetition, and laying over againe of the same thing. The other way is, that if the cause bee perfect in the nature of being a cause, then the effect is: which is as much as to say, that if nothing be wanting to the cause, abstracting precisely from the effect; then neither is

1.
The explication, and proofe of that maxime, that, if the cause be in act, the effect must also be.

the effect wanting. And this is the meaning of Aristotles Axiome : of the truth and evidence whereof in this sense, if any man should make the least doubt, it were easie to evince it : as thus; if nothing be wanting but the effect, and yet the effect doth not immediatly follow, it must needs be, that it cannot follow at all ; for if it can, and doth not, then something more must bee done to make it follow : which is against the supposition, that nothing was wanting but the effect ; for that which it is to be done, was wanting. To say, it will follow without any change, is senselesse : for if it follow without change, if followeth out of this, which is already put: but if it doe follow out of this which is precisely put, then it followeth, against the supposition, which was, that it did not follow, although this were put.

2. This then being evident, let us apply it to our purpose; and let us put three or more things, namely A. B. C. and D : whereof none can worke otherwise, then in a instant or indivisibly : and I say, that whatsoever these four things are able to doe, without respect to any other thing besides them, is compleatly done in the first instant of their being put : and if they remaine for all eternity, without communication or respect to any other thing, there shall never be any innovation in any of them, or any further working among them : but they will alwaies remaine immutable, in the same state they were in, at the very first instant of their being put: for whatsoever A. can doe, in the first instant, is in that first instant actually done; because he worketh indivisibly : and what can be done precisely by A. and by his action joyned to B. doth precisely follow out of A. and his action, and out of B; and his action, if B. have any action independent of A. and because all these are in the same instant, whatsoever followeth precisely out of these, and out of any thing else that is in the same instant, and that worketh indivisibly as they doe ; is necessarily done in that very instant ; but all the actions of C. and D. and of whatsoever by reflection from them may be done by A. and B. being all of them indivisible, and following precisely out of some of the forenamed actions ; they doe follow out of things being in this instant : and because they are indivisible, they may be in this instant. : and therefore, all is done in this instant. Now, supposing all to be done that can be done by them in this instant ; and that nothing can follow from them, unless it follow precisely out of what is in this instant ; and that it is all indivisible.

it followeth clearly, that whatsoever (concerning them) is not in this instant, can never be.

These two conclusions being thus demonstrated, let us in the next place determine, how all actions of pure spirits, which have no respect to bodies, must of necessity be indivisible; that is, must include no continue succession: by which, I meane such a succession, as may be divided into parts without end: for if wee looke well into it, wee shall finde, that a continue succession cannot bee a thing, which hath in it self a *Being*: and the reason is, because the essence of such a succession, consisteth in having som of its parts already passed, and others of them yet to come: but on the other side, it is evident, that no such thing can bee, whose essentiall ingredients are not it selfe: and therefore it followeth evidently, that such a thing as we call succession, can have no being in it selfe: seeing that one essentiall part of it, never is with the other: therefore, such a succession, must have its being in some permanent thing, which must bee divisible; for that is essentially required in succession: but permanent divisibility is that, which wee call *Biggenesse* or *Quantity*; from which pure spirits are free: and therefore, it is most evident, that all their actions in respect of themselves, are absolutely indivisible.

3;
All pure spirits doe worke instantaneously.

Now, to make use of this doctrine to our intent: we say, that since our soule, when it is separated from our body, is a pure spirit or understanding; and that all her actions are indivisible; and that all actions of other spirits upon her must likewise be such; and by consequence, that there can be no continue succession of action among them: wee must of necessity conclude, that according to the private nature of the soule, and according to the common notion of spirituall things; there can bee no change made in her, after the first instant of her parting from her body: but, what happinesse or misery betideth her in that instant, continueth with her for all eternity. Yet it is not my minde to say, that by the course of the universall resolutions, from which she is not wholly exempt, & from supernaturall administration of corporall things, there may not result some change in her. But the consideration of that matter, I remitt to those treatises, unto which it belongeth; as not depending, nor ensuing from the particular nature of the soule: and therefore, not falling under our discussion in this place.

4;
That a soule separated from her body can not suffer any change after the first instant of her separation,

This same conclusion may bee proved by an other argument.

ment, besides this which we have now used ; and it is this. Whatso-
 ever worketh purely by understading and minde, cannot bee chan-
 ged in its operations, unlesse its understanding or minde be altered :
 but this cannot happen, unlesse eyther it leane somewhat, it knew
 not before ; or forgetting a foreknowne truth, it beginne after-
 wards to thinke a falsity. This second part, is impossible, as wee
 have already shewed, when we proved that falsehood could have no
 admittance into a separated soule : and the former is as impossible ;
 it being likewise proved, that at her first instant of her separation,
 she knoweth all things : wherefore, we may hence confidently con-
 clude, that no change of minde, (that is no change at all) can hap-
 pen to an abstracted soule.

5.
 That tempo-
 rall finnes are
 justly punished
 with eternall
 paines.

And thus, by discourse, we may arrive, to quit our selves easily
 of that famous objection, so much pestering Christian Religion ;
 how God, can in justice impose eternall paines upon a soule, for one
 sinne, acted in a short space of time. For we see, it followeth by the
 necessary course of nature, that if a man die in a disorderly affection
 to any thing, as to his chiefe good, hee eternally remaineth by the
 necessity of his owne nature, in the same affection : and there is no
 imparity, that to eternall sinne, there should bee imposed eternall
 punishment.

THE

THE CONCLVSION.



And now I hope, I may confidently say, I have been as good as my word: and I doubt not, but my Reader will finde it so, if he spend but halfe as much time in perusing these two treatises, as the composing them hath cost me. They are too nice (and indeede, unreasonable) who expect to attaine with-

out paines, unto that, which hath cost others, yeares of toyle. Let us carefully pursue the hidden bounties, he hath treasured up for us. Let them remember the words of holy *Job*, that *wisdomes is not found in the hand of those, that live at their ease.* Let them cast their eyes on every side round about them, and then tell me, if they meet with any employment, that may bee compared to the attaining unto these, and such like principles; whereby a man is enabled to governe himselfe understandingly and knowingly, towards the happinesse, both of the next life and of this; and to comprehend the wisemans theme; *what is good for a man in the dayes of his vanity, whiles he playeth the stranger under the sunne.* Let us feare Gods Judgements. Let us thanke him for the knowledge he hath given us: and admire the excellency of Christian Religion; which so plainly teacheth us that, unto which it is so extreme hard to arrive by naturall meanes. Let us blesse him, that we are borne unto it. And let us sing to him; *That it is he, who preacheth his doctrine to Jacob, and giveth his lawes to Israel. He hath not done the like to all nations; nor hath hee manifested his secret truths unto them.*

But before I cut of this thread, which hath cost mee so much paines to spinne out to this Length; I must crave my Readers leave, to make some use of it, for my owne behoofe. Hitherto my discours hath bene directed to him: now I shall entreate his patience: that I may reflect it in a word or two upon my selfe. And as I am sure I have profited my selfe not a little, by talking all this while to him, that obliging me to polish my conceptions with more care, and to range them into better order, then whiles they were but rude meditations within my owne breast; so I hope, that a little

conversacion with my selfe upon this important subject, (which is to be studied for use, and practise; not for speculative science) may prove advantageous unto him; if his warmed thoughts have turned his soule to such a key, as I am sure these considerations have wound up mine unto.

To thee then my soule, I now addresse my speech. For since by long debate, and toyle some rowing against the impetuous tydes of ignorance, and false apprehensions, which overflow thy bankes, & hurry thee headlong down the streame, whiles thou art imprisoned in thy clayie mansion; we have with much adoe arrived to ayme at some litle atome of thy vast greatnesse; and with the hard and tough blowes of strict and wary reasoning, wee have stricken out some few sparkes of that glorious light, which environeth and swelleth thee, or rather, which is thee: it is high time, I should retire my selfe out of the turbulent & slippery field of eager strife and litigious disputation, to make my accounts with thee; where no outward noise may distract us, nor any way intermeddle between us, excepting only that eternall verity, which by thee shineth upon my faint and gloomy eyes; and in which I see, whatsoever doth or can content thee in me. I have discovered, that thou (my soule) wilt survive me: and so survive mee, as thou wilt also survive the mortality, and changes which belong to me; and which are but accidentary to thee, meerely because thou art in me. Then shall the vicissitude of time, and the inequality of dispositions in thee, be turned into the constancy of immortality; and into the evennesse of one being, never to end, and never to receive a change, or succession to better or worse.

When my eye of contemplation hath bene fixed upon this bright sunne, as long as it is able to endure the radiant beames of it; whose redundant light veyleth the looker on, with a darke mist: let me turne it for a little space, upon the straight passage, and narrow gullet, through which thou strivest (my soule) with faint and wearie steppes, during thy hazardous voyage upon the earth, to make thy selfe away: and let me examine, what comparison there is, between thy two conditions; the present one, wherein thou now findest thy selfe immersed in flesh and blood; and the future state that will betide thee, when thou shalt bee melted out of this grosse oare, and refined from this meane alloy. Let my terme of life, be of a thousand long yeares; longer then ever happened to our aged forefathers, who stored the earth with their numerous

progeny, by out living their skill to number the diffused multitudes that swarmed from their loynes: let me, during this long space, be sole Emperour and absolute Lord, of all the huge globe of land and water, encompassed with Adams offspring: let all my subjects lye prostrate at my feet, with obedience and awe, distilling their activest thoughts, in studying day and night to invent new pleasures and delight for me: let nature conspire with them, to give me a constant and vigorous health; a perpetuall spring of youth, that may to the full, relish whatsoever good all they can fancy: let gravest Prelates, and greatest Princes, serve in stead of flatterers to highten my joyes; and yet those joyes, be raised above their power of flattery: let the wisdom of this vast family (whose sentiments, are maximes and oracles, to governe the worlds believes and actions) esteeme, reverence, and adorne me in the secretest, and the most recluse withdrawings of their hearts: let all the wealth, which to this very day, hath ever beene torne out of the bowels of the earth; and all the treasures, which the sea hideth from the view of greedy men, swell round about me; whilst all the world besides, lyeth gaping to receive the crummes, that fall neglected by me, from my full loaden table: let my imagination bee as vast, as the unfathomed Univerfity; and let my felicity be as accomplished, as my imagination can reach unto; so that following in pleasure, I be not able to thinke how to increase it, or what to wish for more, then that which I possesse and enjoy.

Thus when my thoughts are at a stand, and can raise my present happinesse no higher; let me call to minde, how this long lease of pleasant dayes, will in time come to an end: this bottome of a thousand joyfull yeares, will at length bee unwound, and nothing remaine of it: and then (my soule) thy infinitely longer lived Immortality will succeed; they never ending date, will beginne a new account, impossible to be summed up, and beyond all proportion infinitely exceeding the happinesse, we have rudely aymed to expresse: so that no comparison can be admitted betweene them. For, suppose first that such it were, as the least and shortest of those manifold joyes, which swell it to that height we have fancied, were equall to all the contentment thou should'st enjoy in a whole million of yeares; yet millions of yeares may be so often multiplied, as at length, the slender and limited contentments supposed in them, may equalyse, and outgoe the whole heape of overflowing blisse,

raised so high, in the large extent of these thousand happy yeares. Which when they are cast into a totall summe; and that I compare it, with the unmeasurable eternity, which onely measureth thee; then I see, that all this huge product of Algebraicall multiplication, appeareth as nothing, in respect of thy remayning, and never ending survivance; and is lesse, then the least point in regard of the immense Vniverse. But then, if it bee true (as it is most true) that thy least sparke and moment of reall happinesse, in that blessed eternity thou hopest for, is infinitely greater, and nobler, then the whole masse of fancied joyes, of my thousand yeares life here on earth; how infinitely will the value of thy duration, exceede all proportion, in regard of the felicity, I had imagined my selfe? And seeing there is no proportion betweene them, let mee sadly reflect upon my owne present condition: let me examine what it is, I so busily, and anxiously, employ my thoughts and pretious time upon: let me consider my owne courses, and whether they leade me: let me take a survey of the lives, and actions, of the greatest part of the world, which make so loude a noyse about my eares: and then may I justly sigh out from the bottome of my anguished hart; to what purpose have I hitherto lived? To what purpose are all these millions of toylefome aunes, that live and labour about me? To what purpose were Cesars and Alexanders? To what purpose Aristotles and Archimedes? How miserably foolish are those conquering tyrants, that divide the world with their lawlesse swords? What senselesse idiots those acute Philosophers, who teare mens witts in pieces, by their different waies, and subtile Logicke; striving to shew men beatitudes in this world, and seeking for that, which if they had found, were but a nothing of a nothing in respect of true beatitude? He onely is wise, who neglecting all that flesh and blood desireth, endeavoreth to purchase at any rate this felicity, which thy survivance promiseth: the least degree of which, so farre surmounteth all the heapes, which the Gyants of the earth are able to raise, by throwing hills upon hills, and striving in vaine to scale and reach those eternities, which reside about the skyes. Alasse how fondly doth mankind suffer it selfe to be deluded? How true it is, that the onely thing necessary, proveth the only that is neglected? Looke up my soule, and fixe thine eye upon that truth, which eternall light maketh so cleare unto thee, shining upon thy face with so great evidence, as defyeth the noonetyde sunne, in its greatest brightnesse.

And

And this it is, that every action of thine, bee it never so slight, is mainly mischievous; or bee it never so bedeckt, with those specious considerations, which the wise men of the world judge important, is foolish, absurd, and unworthy of a man; and unworthy of one that understandeth, and acknowledgeth thy dignity; if in it there be any specke; or if through it, there appeare any sparke of those meane and flat motives, which with a false byas, draw any way aside, from attaining that happinesse, we expect in thee. That happinesse, ought to bee the end, and marke weelevell at: that, the rule and model of all our actions: that, the measure of every circumstance, of every atome, of whatsoever we bestow so pretious a thing upon, as the employment of thee is.

But we must not so slightly passe over the intenseness and vehemence of that felicitie which thou (my soule) shalt enjoy, when thou art severed from thy benumbing compartner. I see evidently, that thou dost not survive, a simple and dull essence; but art replenished with a vast and incomprehensible extent of riches and delight within thy selfe. I see that golden chayne, which here by long discourses, filleth huge volumes of Bookes, and diveth into the hidden natures of severall bodies: in the resumed into one circle or linke, which containeth in it selfe the large scope of whatsoever screwing discourse can reach unto. I see it comprehend, and master the whole world of bodies. I see every particular nature, as it were embossed out to the life, in thy celestiall garment. I see every solitary substance ranked in its due place and order, not crushed or thronged by the multitude of its fellowes; but each of them in its full extent, in the full propriety of every part and effect of it; and distinguished into more divisions, then ever nature severed it into. In thee I see an infinite multitude enjoy place enough. I see, that neither height, nor profundity, nor longitude enough, nor latitude, are able to exempt themselves from defused powers: they faddome all; they comprehend all; they master all, they enrich thee with the flocke of all; and thou thy selfe art all, and somewhat more then all; and yet, now but one of all. I see, that every one of this all, in thee encreaseth the strength, by which thou knowest any other of the same all: and all, encreaseth the knowledge of all, by a multiplication beyond the skill of Arithmeticke; being (in its kinde) absolutely infinite; by having a nature, that is incapable of being either infinite or finite. I see againe, that those things which have

not knowledge, are situated in the lowest, and meanest rancke of creatures; and are in no wise comparable to those which know. I see, there is no pleasure at all, no happineffe, no felicity, but by knowledge, and in knowledge. Experience teacheth me, how the purer, and nobler race of mankind, adoreth in their hearts, this idoll of knowledge, and scorneth what ever else they seeme to court, and to be fond of. And I see, that this excesse of sea of knowledge which is in thee, groweth not by the succession of one thought after another; but it is like a full swolne ocean, never ebbing on any coast, but equally pushing at all its bounds, and tumbling out its flowing waves on every side, and into every creche; so that every where it maketh high tide. Or like a pure sunne, which from all parts of it shooteth its radiant beames with a like extreimity of violence. And I see likewise, that this admirable knowledge, is not begotten & conserved in thee, by the accidentary helpe of defective causes; but is rooted in thy selfe; is steeped in thy owne essence, like an vnextinguishable fource of a perpetually streaming fire; or like the living head of an everrunning spring; beholding to none, out of thy selfe, saving only to thy Almighty Creatour; and begging of none; but being in thy selfe all that of which thou shouldest begge.

This then (my soule) being thy lott; and such a hieght of pleasure being reserved for thee; and such an extreimity of felicity, with in a short space attending thee; can any degenerate thought, ever gaine strength enough, to shake the evidence which these considerations implant and rivet in thee? Can any dull oblivion deface this so lively and so beautifull image? Or can any length of time, draw in thy memory a veyle betweene it, and thy present attention? Can any perversity, so distort thy straight eyes, that thou shouldest not looke alwaies fixed upon this marke; and levell thy ayme directly at this white? How is it possible, that thou canst brooke to live, and not expire presently, thereby to ingulfe thy selfe, and be thoroughly imbibed with such an overflowing blisse? Why dost thou not breake the walles and the chaynes of thy flesh and blood; and leape into this glorious liberty? Here Stoickes, you are to use your swords. Vpon these considerations, you may justifie the letting out the blood, which by your discourfes, you seeme so prodigall of. To die upon these termes, is not to part with that, which you fondly call happie life; feeding your selves, and flattering your hearts.

hearts with empty words : but rather it is, to plunge your selves into a felicity, you were never able to imagine, or to frame it to your misguided thoughts any scantling of.

But nature pulleth me by the eares, and warneth me from being so wrongfull to her, as to conceive, that so wise a governesse should to no advantage, condemne mankind so long a banishment, as the ordinary extent of his dull life, and wearisome pilgrimage here under the sunne reacheth unto. Can we imagine, shee would allow him so much layisie time, to effect nothing in ? Or can wee suspect that shee intended him no further advantage, then what an abortive child arriveth unto in his mothers wombe ? For what soever the netts and toyles of discouise can circle in, all that he, who but once knoweth that himselfe is, can attaine unto as fully, as hee that is enriched with the science of all things in the world. For the connexion of things, is so linked together, that proceeding from any one, you reach the knowledge of many ; and from many, you cannot faile of attaining of all : so that a separated soule, which doth but know her selfe, cannot chuse but know her body too ; and from her body, shee cannot misse in proceeding from the causes of them both, as farre as immediate causes doe proceede from others over them : and as litle can shee bee ignorant, of all the effects of those causes she reacheth unto. And thus, all that huge masse of knowledge, and happinesse which we have considered in our last reflection, amounteth to no more, then the silliest soule buried in warme blood, can and will infallibly attaine unto, when its time commeth. We may then assure our selves, that just nature hath provided and designed a greater measure of such felicity for longer livers : and so much greater, as may well be worth the paines and hazards, of so miserable and tedious a passage, as here (my soule) thou strugglest through. For certainly, if the dull perfection, which by natures institution, hammereth out a spirituall soule from grosse flesh and blood, can atcheive so wondrous an effect, by such blunt instruments, as are used in the contriving of a man : how can it bee imagined, but that fifty or a hundred yeares beating upon far more subtil elements, refined in so long a time, as a child is becoming a man, and arriving to his perfect discourse, must necessarily forge out in such a soule, a strange and admirable excellency, about the unlicked forme of an abortive embryon ? Surely, those innumerable strokes (every one of which maketh a strong impression in the soules

upon whom they beate) cannot choofe but worke a mighty difference, in the ſubject that receiveth them, changing it ſtrangely from the condition it was in, before they begun to new mould it. What if I ſhould ſay, the odds betweene two ſuch ſoules, may peradventure bee not unlike the difference, betweene the witts and judgements of, the ſubtleſt Philoſopher that ever was, and of the dulleſt childe or idiote living. But this compariſon falleth too ſhort by farre: even ſo much, that there is no reſemblance or proportion betweene the things compared: for as the exceſſe of great numbers over one another, drowneth the exceſſe of ſmall ones, and maketh it not conſiderable, in reſpect of theirs; although they ſhould bee in the ſame proportion; ſo the advantages of a ſoule, forged to its higheſt perfection in a mans body, by its long abode there, and by its making right uſe of that pretious time allowed it; muſt needs (in poſitive valew, though not in geometricall proportion) infinitely exceede, when it ſhall be delivered out of priſon, the advantages, which the newly hatched ſoule of an abortive infant ſhall acquire, at the breaking of its chaines. In this caſe, I beleeve no man would be of Cæſars minde; when he wiſhed to bee rather the firſt man in a contemptible poore village, hee paſſed through among the deſert mountaines, then the ſecond man in Rome. Let us ſuppoſe, the wealth of the richeſt man in that barren habitation, to be one hundred Crownes; and that the next to him in ſubſtance, had but halfe ſo much as he: in like manner, in that opulent Citie, the head of the world, where millions were as familiar as pence in other places, let the exceſſe of the richeſt mans wealth, be but (as in the former) double over his, that commeth next unto him; and there you ſhall finde, that if the pooreſt of the two, be worth fifty millions, the other hath fifty millions more then he: whereas the formers petty treaſure, exceedeth his neighbours but by fifty crownes. What proportion is there, in the common eſtimation of affaires, between that triviall ſumme, and fifty millions? Much leſſe is there, between the excellency of a ſeparated ſoule, firſt perfected in its body, and another that is ſet looſe into compleate liberty, before its body arrived in a naturall courſe, to be delivered into this world, and by its eye to enjoy the light of it. The change of every ſoule at its ſeparation from the body, to a degree of perfection, above what is enjoyed in the body, is in a manner infinite: and by a like infinite proportion, every degree of perfection it had in the body, is alſo then multiply-
ed:

ed: what a vast product then of infinity, must necessarily be raised, by this multiplying instant of the soules attaining liberty, in a well moulded soule; infinitely beyond that perfection, which the soule of an infant dying before it be borne, arriveth unto? And yet wee have determined that to bee in a manner infinite. Here our skill of Arithmeticke and proportions sayleth us. Here we find infinite excessse, over what we also know to bee infinite. How this can bee the feeble eyes of our limited understanding, are too dull to penetrate into: but that it is so, we are sure: the rigour of discourse, convinceth and necessarily concludeth it. That assureth us, that since every impression upon the soule, while it is in its body, maketh a change in it; were there no others made, but merely the iterating of those acts, which brought it from ignorance to knowledge; that soule, upon which a hundred of those acts had wrought, must have a hundred degrees of advantage over an other, upon which only one had beaten; though by that one, it had acquired perfect knowledge of that thing: and then in the separation, these hundred degrees, being each of them infinitely multiplied, how infinitely must such a soule exceed in that particular, (though wee know not how) the knowledge of the other soule; which though it be perfect in its kind, yet had but one act to forge it out? When we arrive to understand the difference of knowledge, betweene the superiour and inferiour rankes of intelligences; among whom, the lowest knoweth as much as the highest; and yet the knowledge of the highest, is infinitely more perfect and admirable, then the knowledge of his inferiours: then, and not before, we shall throughly comprehend this mystery. In the meane time, it is enough for us, that we are sure, that thus it faireth with soules: and that by how much the excellency and perfection of an all-knowing and all-comprehending soule, delivered out of the body of a wretched embryo, is above the vilenesse of that heaive lumpe of flesh, it lately quited in his mothers wombe; even by so much, and according to the same proportion, must the excellency of a compleate soule (compleated in its body) be in a pitch above the adorable majesty, wisdom, and augustnesse, of the greatest and most admired oracle in the world, living embodied in flesh and blood. Which as it is in a height, and eminency over such an excellent and admirable man, infinitely beyond the excessse of such a man, over that silly lumpe of flesh, which composeth the most contemptible idiote or embryo; so likewise, is the excessse

cessè of it, over the soule of an abortive embryon, (though by the separation, growne never so knowing, and never so perfect) infinitely greater, then the dignity and wisdomè of such a man, is above the feebleness and miserie of a new animated child. Therefore have patience my soule: repine not at thy longer stay here in this vaile of misery, where thou art banished from those unspeakeable joyes thou seest at hand before thee. Thou shalt have an overflowing reward for thy enduring and patienting in this thy darksome prison. Deprive not thy selfe through mischievous hast, of the great hopes and admirable felicity that attend thee, canst thou but with due temper stay for it. Be content to let thy stock lye out a while at interest; thy profits wil come in vast proportions; and every yeare, every day, every houre, will pay thee interest upon interest: and the longer it runneth on, the more it multiplyeth: and in the account thou shalt finde, if thou proceedest as thou shouldest, that one moment oftentimes bringeth in a greater increase unto thy stocke of treasure, then the many yeares thou didst live and trade before: and the longer thou livest, the thicker will these moments arrive unto thee. In like manner as in Arithmetically numeration, every addition of the least figure, multiplyeth the whole some it findeth. Here thou wilt prove how true that rich man said, who of his gaires pronounced, that hee had gotten little with great labour, and great summes with little: so if thou bestowest well thy time, thy latter summes will bring thee in huge accounts of gaine, upon small expence of paines or employments; whereas thy first beginnings are toylefome and full of paine, and bring in but slender profit.

By this time, my soule, I am sure thou art satisfied, that the excessè of knowledge & of pleasure, which thou shalt enjoy, is vastly beyond any thou art capeable of here. But how may we esteeme the just proportion they have to one another? (Or rather is not the pleasure of a separated soule, so infinitely beyond all that can be relished by one embodied here in clay, that there is no proportion betweene them?) At the least, though we are not able to measure the one, let us doe our best to ayme and guesse at the improportion betweene them; and rejoyce that we finde that it is beyond our reach to conceive or imagine any thing, nigh the truth & the huge excessè of thy good (my soule) over the most I am capeable of in this world. It is agreed, that the vehemence and intenseness of any pleasure, is proportionable to the activity, power, and energy of the subject, which

is affected with such pleasure; and to the gravitation, bent, and greatnesse, that such a subject hath to the object that delighteth it. Now to rove at the force and activity, wherewith a separated soule weigheth and striveth to joyne it selfe, to what its nature carrieth it unto; let us beginne with considering the proportions of celerity and forciblenesse, wherewith heavie bodies move downwards. I see a pound weight in one scale of the ballance, weigheth up the other empty one with great celerity. But if into that you imagine a million of pounds to be put, you may well conceive, that this great excesse, would carry up the single pound weight with so much violence and speed, as would hardly afford your eye liberty to observe the velocity of the motion. Let me multiply this million of pounds by the whole globe of the earth; by the vast extent of the great orbe, made by the sonnes, or earthes motion about the center of the world; by the incomprehensibility of that immense store-house of matter and of bodies, which is designed in lumpe by the name of the Vniverse; of which we know no more, but that it is beyond all hope of being knowne, during this mortall life. Thus when I have heaped together a bulke of weight, equall to this unwieldy machine; let me multiply the strength of its velocity, and pressure over the least atome imaginable in nature, as farre beyond the limits of gravity, as the ingenious skill, wherewith Archimedes numbred the least graines of sand that would fill the world, can carry it: and when I have thus wearied my selfe, and exhausted the power of Arithmetick, and of Algebra, I finde there is still a proportion betweene that atome and this unutterable weight: I see it is all quantitative; it is all finite; and all this excesse vanisheth to nothing, and becommeth invisible (like twinkling starres, at the rising of the much brighter sunne) as soone as the lowest and the meanest substance shineth out of that orbe, where they reside that scorne divisibility, and are out of the reach of quantity and matter. How vehement then must the activity and energy be, wherewith so puissant a substance shooteth it selfe to its desired object; and when it enjoyeth it, how violent must the extasie and transport be, wherewith it is delighted? How is it possible then for my narrow hart, to frame an apprehension of the infinite excesse of thy pleasure (my soule) over all the pleasure this limited world can afford, which is all measured by such petty proportions? How should I stampe a figure of thy immense greatnesse, into my materiall imagination? Here I

loose my power of speaking, because I have too much to speake of: I must become silent and dumbe, because all the words and language I can use, expresse not the thousandeth, nor the millioneth part, of what I evidently see to be true. All I can say is, that whatsoever I thinke or imagine, it is not that: and that it is not like any of those things; unto some of which unlesse it be like, it is impossible for me to make any proportion or similitude unto it. What then shall I doe, but lay my selfe downe in mine owne shadow, and there rejoyce that thou art a light so great, as I am not able to endure the dazeling splendour of thy rayes: that thy pleasure is so excessive, as no part of it can enter into my circumscribed heart, without dilating it so wide, that it must breake in sunder: and that thy happinesse is so infinite, as the highest pitch I can hope for to glut my selfe withall, during this darke night of my tedious pilgrimage here on earth, is to see evidently, that it is impossible for me in this life, to frame any scantling of it; much lesse, to know how great it is. Shall I then once againe presume to breake out into impatience, at my delay of so great blisse, and cry out that I am content with the meanest share of this exuberant felicity? I care not for the exaggerations which a longer life may heape up unto it. I am sure here is sufficient to swell my heart beyond it selfe, to satisfie my thirsty soule, to dissolve and melt all my powers, and to transforme me totally into a selfe blessed creature. Away, away all tedious hopes, not only of this life, but even of all increase in the next. I will leape boldly into that fountaine of blisse, and cast my selfe headlong into that sea of felicity; where I can neither apprehend shallow waters, nor feare I shall be so little immerged and drowned, as to meete with any shelve or dry ground, to moderate and stint my happinesse. A selfe activity, and unbounded extent, and essence free from time and place, assure me sufficiently, that I neede desire no more. Which way soever I looke, I loose my sight, in seeing an infinity round about me. Length without points: Breadth without Lines: Depth without any surface. All content, all pleasure, all restless rest, all an unquietnesse and transport of delight, all an extasie of fruition.

Happie forgetfulnesse, how deeply am I obliged to thee, for making roome for this soule ravishing contemplation, by removing this whiles all other images of things farre from me? I would to God thou mightest endure, whiles I endure; that so I might be drowned

drowned in this present thought, and never wake againe, but into the enjoying, and accomplishment of my present enflamed desires. But alas, that may not be. The eternall light whom my soule and I have chosen for Arbiter, to determine unto us what is most expedient for us, will not permit it. We must returne; and that into teares and miseries: For as a good life breedeth increase of happinesse, so doth an evill one, heape up Iliads of woe. First (my soule) before I venture, we should be certaine, that thy parting from this life, waite thee over to assured happinesse: For thou well knowest, that there are noxious actions, which deprave and infect the soule, whiles it is forging and moulding here its body, and tempering for its future being: and if thou shouldst fall hence in such a perverse disposition, unhappinesse would betide thee in stead of thy presumed blisse. I see some men so ravenous after those pleasures, which cannot bee enjoyed out of the body, that if those impotent desires accompany their soules into eternity, I cannot doubt of their enduring an eternity of misery: I cannot doubt of their being tormented with such a dire extremitie, of unsatisfiable desire and violent greife, as were able to teare all this world into pieces; were it converted into one heart; and to rive in sunder, any thing lesse then the necessity of contradiction. How high the blisse of a well governed soule is above all power of quantitie, so extreme must the ravenous inclemency, and vulturelike cruelty, bee of such an uncompassable desire gnawing eternally upon the soule; for the same reason holdeth in both: and which way soever the gravitation and desires of a separated soule doe carry it, it is hurried on with a like impetuosity and unlimited activity. Let me then cast an heedfull and warie eye, upon the actions of the generality of mankind, from whence I may guesse at the weale or woe, of their future state: and if I finde that the greatest number weigheth downe in the scale of misery, have I not reason to feare least my lot should prove among theirs? For the greatest part sweepeth along with it every particular, that hath not some particular reason to exempt it from the generall law. In stead then of a few that wisely settle their hearts on legitimate desires, what multitudes of wretched men doe I see; some hungry after flesh and blood; others gaping after the empty winde of honour and vanity; others breathing nothing but ambitious thoughts; others grasping all, and groveling upon heapes of melted earth? So that they put me all in a horrour, and make me feare, least very few

they be, that are exempted from the dreadfull fate of this incomprehensible misery, to which I see, and grieve to see, the whole face of mankind desperately turned. May it not then be my sad chance, to be one of their unhappy number? Be content then, fond man, to live. Live yet, till thou hast first secured the passage which thou art but once to venture on. Be sure before thou throwest thy selfe into it, to put thy soule into the scales: ballance all thy thoughts; examine all thy inclinations; put thy selfe to the test, try what drosse, what pure gold is in thy selfe: and what thou findest wanting, be sure to supply, before nature calleth thee to thy dreadfull account. It is soone done, if thou beest what thy nature dictateth thee to be. Follow but evident reason and knowledge, and thy wants are supplied, thy accounts are made up. The same ever shining truth, which maketh thee see that two and two are foure, will shew thee without any contradiction, how all these base allurements are vaine & idle; & that there is no comparison between the highest of them, and the meanest of what thou mayest hope for, hast thou but strength to settle thy heart by the steerage of this most evident science; in this very moment, thou mayest be secure. But the hazard is great, in missing to examine thy selfe truely and thoroughly. And if thou miscarry there, thou art lost for ever. Apply therefore all thy care, all thy industry to that. Let that be thy continuall study, and thy perpetuall entertainment. Thinke nothing else worth the knowing, nothing else worth the doing, but screwing up thy soule unto this height, but directing it by this leuell, by this rule. Then feare not, nor admit the least doubt of thy being happy, when thy time shall come; and that time shall have no more power over thee. In the meane season, spare no paines, forbear no diligence, employ all exactnesse, burne in summer, freeze in winter, watch by night, and labour by day, joyne monethes to monethes, entayle yeares upon yeares. Thinke nothing sufficient to prevent so maine a hazard; and deeme nothing long or tedious in this life, to purchase so happy an eternity. The first discoverers of the Indies, cast themselves among swarmes of maneters; they fought and struggled with unknowne waves; so horrid ones, that often times they perswade themselves they climbed up mountaines of waters, and straight againe were precipitated headlong downe betweene the cloven sea, upon the foaming sand, from whence they could not hope for a resource: hunger was their foode; snakes and serpents.

serpents were their dainties; sword and fire were their daily exercise: and all this, only to be masters of a little gold, which after a short possession was to quit them for ever. Our searchers after the Northerne passage, have cut their way through mountaines of yce, more affrightfull and horrible, then the Sympleyader. They have imprisoned themselves in halfe yeare nights; they have chayned themselves in perpetuall stone-cleaving colds: some have beene found closely imbracing one another, to conserve as long as they were able, a litle sewell in their freezing hearts, at length petrified by the hardnesse of their unmercifulnesse of that unmercifull winter: others have beene made the prey of unhumaine men, more savage then the wildest beafts: others have beene never found nor heard of, so that surely they have proved the foode of ugly monsters of that vast icy sea: and these have beene able and understanding men. What motives, what hopes had these daring men? What gaines could they promise themselves, to countervail their desperate attempts? They aimed not so much as at the purchase of any treasure for themselves, but meerely to second the desires of those that set them on worke; or to fill the mouthes of others, from whence some few crummes might fall to them. What is required at thy hands (my soule) like this? And yet the hazard thou art to avoide, and the wealth thou art to attaine unto, incomparably over-setteth all that they could hope for. Live then and bee glad of long and numerous yeares; that like ripe fruit, thou mayest drop securely into that passage, which duely entred into, shall deliver thee into an eternity of blisse, and of unperishable happinesse.

And yet (my soule) be thou not too soare agast, with the apprehension of the dreadful hazard thou art in. Let not a tormenting feare of the dangers that surrounded thee, make thy whole life here bitter and uncomfortable to thee. Let the serious and due consideration of them, arme thee with caution and wisdomie, to prevent miscarriage by them. But to looke upon them with horreur and affrightednesse, would freeze thy spirits, and benumme thy actions, and peradventure engulfe thee through pusillanimity in as great mischeifes, as thou seekest to avoid. Tis true, the harme which would accrue from misgoverning thy passage out of this life, is unspeakable, is unimaginable. But why shouldst thou take so deepe thoughts of the hazard thou runnest therein, as though the difficulty of avoiding it were so extreme, as might amount to an impossibility.

I allow, the thoughts that arme thee with wise caution to secure thy selfe, cannot be too deepe nor too serious; but when thou hast providently stored thy selfe with such, call thy spirits manfully about thee: and to encourage thee to fight confidently, or rather to secure thee of victory, so thou wilt not forsake thy selfe, turne thine eyes round about thee, and consider how wise nature, that hath prescribed an end and period unto all her plants, hath furnished them all with due and orderly meanes to attaine thereunto: and though particulars sometimes miscarry in their journey (since contingence is entayled to all created things yet in the generality, and for the most part, they all arrive unto the scope she levelleth them at. Why then should we imagine, that so judicious and farre looking an Architect, whom we see so accurate in his meaner workes, should have framed this masterpiece of the world, to perish by the way, and never to attaine unto that great end, for which he made it, even after he is prepared and armed with all advantagious circumstances agreeable to his nature. That artificer, wee know, deserveth the stile of silly, who frameth such tooles, as faile in their performance, when they are applyed to the action for which they were intended. We see all sorts of trees for the most part beare their fruite in due season; which is the end they are designed unto, and the last and highest emolument they are made to afford us. Few beasts we see there are, but contribute to our service what we looke for at their hands. The swine affordeth good flesh, the sheepe good wooll, the cow good milke, the sable warme and soft furre, the oxe bendeth his sturdy necke to the yoake, the spiritfull horse dutifully beareth the souldier, and the finewy mule and stronger camell convey weighty marchandise. Why then shall even the better sort of mankind, the chiefe, the top, the head, of all the workes of nature, bee apprehended to miscarry from his end in so vast a proportion, as that it should be deemed in a manner impossible, even for those few (for so they are in respect of the other numerous multitude of the worser sort) to attaine unto that felicity which is naturall unto them? Thou (my soule) art the forme, and that supreme part of me, which giveth being both to me & to my body: who then can doubt, but that all the rest of me, is framed fitting and serviceable for thee? For what reason were there, that thou shouldest be implanted in a soyle, which cannot beare thy fruite? The forme of a hogge, I see, is grafted in a body fit and appropriated for a swines operations: the

the forme of a horse, of a lyon, of a wolfe, all of them have their organs proportioned to the mastering piece within them, their soule. And is it credible, that only man, should have his inferiour parts raised so highly in rebellion against his soule, the greatest Mistresse (beyond proportion) among all formes, as that it shall be impossible for her to suppress their mutinies, though she guide her selfe never so exactly by the prescripts of that rule, which is borne with her? Can it be suspected, that his forme, which is infinitely mounted about the power of matter, should through the very necessity and principles of its owne nature, be more liable to contingency, then those that are engulfed and drowned in it; since we know, that contingency, defectibility, and change, are the lame children of grosse and mishapen matter.

Alas it is too true, that nature is in us unhappily wrested from her originall & due course. We find by sad experience, that although her depravation bee not so total, as to blind entirely the eye of Reason she seeth by, yet it is so great, as to carry vehemently our affections quite crosse to what she proposeth us as best. Howsoever let the incentives of flesh and blood bee never so violent, to tumble humane nature downe the hill, yet if a contrary force, more efficacious then they with all their turbulent and misty steames, doe impell it another way, it must needs obey that stronger power. Let us then examine whose motives, the soules, or the senses, in their owne nature, worke most efficaciously in man: We are sure, that what pleasure he receiveth, he receiveth by meanes of his soule; even all corporall pleasure: for, bee the working object never so agreeable and pleasing unto him, he reapeth thence small delight, if in the meane time, his soules attention bee carried another way from it. Certainly then, those things must affect the soule most powerfully, which are conaturall unto her, and which she seisseth upon and relissheth immediately; rather then those impure ones, which come sofisticated to her, through the muddy channels of the senses. And accordingly, all experience teacheth us, that her pleasures, when they are fully favored, are much stronger then the pleasures of our senses. Observe but the different comportements of an ambitious, and of a sensuall man: and you will evidently perceive farre stronger motions, and more vehement straines in the former, who hath his desires bent to the satisfaction of his minde; then in the other, who aimeth but at the pleasures of his body. Let us
 looke

looke upon the common face of mankinde; and we shall see the most illustrious and noble part, taken with learning, with power, with honour; and the other part, which maketh sense their idole, moveth in a lower and baser orbe under the others; and is in a servile degree to them. Since then humane nature is of it selfe more inclined to the contentments of the active minde, then of the dull sense; who can doubt but that the way of those pure contentments, must bee farre sweeter then the grosse and troubled streames of sensuall pleasures; which if it bee, certainly man in his owne nature, is more apt to follow that: and when hee chanceth to wander out of that smooth and easie roade, his steps are painefull and wearisome ones: and if he doe not presently perceive them such, it is, because it fareth with him, as with those that walke in their sleepe, and stray into rough and stony passages, or among thistles and bryers; whiles peradventure some illuding dreame bewitcheth their fancies, and perswadeth them they are in some pleasant garden; till waking, (if at least they wake before they fall into a deadly precipice) they finde their feete all gored, and their bodies all scratched and torne. If any sensuall man should doubt of this great truth, and find it hard to perswade himselfe, that intellectuall pleasures (which to his depraved taste, seeme cold and flat ones) should bee more active and intense, then those seculent ones, which so violently transport him; let him but exercise himselfe a while in those entertainements which delight the mind, taking leave during that space, of those unruly ones, which agitate the body; and continue doing thus, till by long practise, hee hath made them easie and habited himselfe unto them: and I will engage my word, that hee will finde this change so advantageous to him, even in contentment and delight, that he will not easily be brought backe to his former course of life. Experience sheweth us, that whatsoever is long customary to us, turneth into our nature; so much, that even diseases and poysons by diuturne use, doe mould and temper to themselves those bodies, which are habituated to them; in such sort, that those pestes of nature must be kept on foote, and fed upon for our substance. How much more then must the most connaturall exercise of mentall pleasure, turne so substantially in our being, that after some good practise in it, we shall not be able, without great struggling and reluctance, to live without it.

The violence of fruition in those foule puddles of flesh and blood,
presently

presently glutted with satiety, and is attended with annoy and with dislike: and the often using and repeating it, weareth away that edge of pleasure, which only maketh it sweete and valuable, even to them that set their hearts upon it; and nothing heighteneth it, but an irritation by a convenient hunger and abstinence. Contrarywise, in the soule, the great and more violent the pleasure is, the more intense and vehement the fruition is; and the oftner it is repeated, so much the greater appetite and desire we have, to returne unto the same; and nothing provoketh us more, then the entire and absolute fruition of it. If a suddaine change from one extreame of flesh and blood, to the other opposite pole of spirituall delights and entertainements, seeme harsh to him, whose thoughts by long assuefaction, are glewed to coporall objects; let him beginne with gently bridling in his inferiour motions under a faire rule of government: If hee cannot presently suppress and totally mortifie their clamorous desires, let him at the least moderate and steere them according to the bent of reason. If wee will but follow this course which nature teacheth us, to heighten even our sensuall delights and pleasures, by reasonable moderation of them to their owne advantage; we shall finde her so kinde a mother to us, that of her selfe she will at length quell and disincumber us of all our enemies. If we but temperately attend her worke, she will quietly waite us over to our desired end, to our beloved happinesse. In a few yeares, by boyling away our unruly heate, shee will abate, and in the end quite weare away the sense of those transporting pleasures, wee used to take so much delight in the fruition of. With in a while, rheumes will so clogge our tongue and palates, that wee shall but flatly relish the most poynant meates. Our dulled eares will no longer devoure with delight, the ravishing sound of sweete harmonies. Our dimme eyes will carry to our heavie fansie but confused newes of any beautifull and pleasing objects. Our stopped nosethrilles will afford no passage for spiritfull perfumes, to warme and recreate our moyst and drowisie braine. In a word, nature will ere long, warne us to take a long farewell of all those contentments and delights, which require a strong, vigorous, and athleticke habite of body to enjoy. She will shew us, by setting our graves before our eyes, how vaine this glittering fansie of honour is: how unprofitable the staffe of power to underproppe our falling being; how more burthen some then helpfull are those massie heapes of gold and sil-

ver, which when we have, the greatest use we make of them, is but to looke upon them, and court them with our dazeled eyes; whiles they encompass us with armies of traytours & of hungry wolves, to teare them from us, and us in pieces for their sake. Thus will nature of her selfe in a short time, dull those weapons that offend us, and destroy the enemies of those verities that shine upon us. Courage then, my soule, and neither feare to live, nor yet desire to die. If thou continuest in thy body, it is easie for thee, and sweete and contentfome, to heape up treasures for eternity. And if thou partest from it, thy hopes are great and faire, that the journey thou art going, is to a world of unknowne felicitie. Take heart then, and march on then with a secure diligence, and expect the hand of bounteous nature, to dispose of thee, according as shee hath wisely and benignely provided for thee. And feare not but that if thou hast kept a reasonable amity with her, she will passe thee to where thou shalt never more bee in danger of jarring with her; nor of feeling within thy selfe the unkind blowes of contrary powers fighting in thee, whiles thou bledest with the woundes that each side giveth; nor of changing thy once gained happinesse into a contrary condition, according to the vicissitudes of all humane affaires. But shalt *For ever*, bee swelled to the utmost extent of thy infinite nature, with this torrent, with this abisse of joy, pleasure, and delight.

But here (my soule) well mayest thou stand amazed at this great word *For ever*. What will this be, when fleeting time shall be converted into permanent eternity? sharpen thy sight to looke into this vast profundity. Suppose that halfe an houre, were resumed into one instant or indivisible of time: what a strange kinde of durance would that be? I see that halfe an houre, is divisible without end, into halves, and halves of halves, and quarters of quarters; and after myriades of divisions, no parcell is so little, but that it hath an infinite superproportion to an indivisible instant. What a prodigious thing then must it be, to have an instant equal life halfe an houre? were it but some ordinary notion or quiddity, as of magnitude, of place, of activity, or the like, in which this excellency of an indivisibles equalising a large extent, were considered; my fantasie would offer to wrestle with it; and peradventure, by strong abstraction, and by deepe retyrement into the closet of judgement, I might hazard to frame some likenesse of it. But that wherein this multiplication

is, is the noblest, the highest, and the roote of all other notions, it is *Being* and *Existence* it selfe. I my selfe, while I am, have my existence determined but to one poore instant of time; and beyond that, I am assured of nothing. My slender thridde of *Being* may breake I still find that it may breake a sunder, as neere to that instant, as I can suppose any thing to be neere unto it: and when I shall have supposed, *Here* it may breake neerer and neerer; and that I can never arrive to settle the neereest point where it may snap in two. But when time shall be no more; or at the least, shall in respect of me, be turned into Eternity; then this fraile Existence of mine, will be stretched out beyond the extent of all conquering time. What strange thing then, is this admirable multiplicacion of existence? or how may I bee able to comprehend it? Existence is that which comprehendeth all things: and if God be not comprehended in it, thereby it is, that he is incomprehensible of us: and he is not comprehended in it, because himselfe is it. He is Existence: and by being so, hee equaleth, not comprehendeth it. From hence then I may gather the excellency and vastempire of existence, in its owne nature: and so conclude how admirable a change and betterment that must bee, which encreaseth, and multiplyeth so infinitely the existance I now enjoy; for be it never so specious; be it never so glorious; be it what it is, existence, the top, the flower, the perfection of all created things; still there is a flaw, there is a defect, a shortnesse, a limitation in it: for now, my soule, thou art but a part of me; and dost exist in such a manner by succession, that the security and possession of it, is of lesse then of any thing whatsoever in the world; for it is of nothing more, then of an indivisible; which being such, in truth is nothing. But when the walls shall be broken downe, that here confine thee to such a nothing of existence, (which yet is infinitely more noble, then all other degrees of notions) then thou shalt summe up time in for small *being*, and not be limited, as now thou art, to this so divided a succession. Thou shalt bee an houre without divisibility: and if an houre, a yeare: if so, an age: an if and age, then for ever, for all eternity.

But whither art thou flowne, my soule? to what a dazeling height art thou mounted? Thou art now soared to such a lessening pitch, as my faint eyes are no longer able to follow thy touring flight: my head groweth giddy, with gazing up; whiles thou lookest downe, to see time runne an infinite distance beneath thee;

wasting the existences of all corporall things from nothing to nothing, in a perpetuall streame : and thou secure, and out of the reach of its venomous and all destroying truth. Let me call to minde, all the violent pleasures of my heady youth : let mee summe up their extent according to those deceitfull measures I then rated happineffe by : let me in my fancy chew over againe the excessive good, I then fondly imagined in them : and to all this, let mee adde as much more joy and felicity, as in my weake thoughts, I am able to faddome or but aime at : and then let me say (and with rigorous truth I shall say it) all this excesse of blisse, will be resumed, will be enjoyed to the full, in one indivisible moment : let mee thinke with my selfe, if then, when pleasure was the Idoll I sacrificed all my thoughts unto, I might in one quarter of an houre have enjoyed a pleasure, or at the least, have hoped for one, that should have equalised at once all those, that in my life I ever tasted : what would not I have beene content to give in purchase of that single quarter of an houre ? and in stead of this pleasant dreame, I now see that one reall moment, will truly and solidely give to thee and me, the quintessence, the Elixir of content and happineffe ; not drawne out of such 40 yeares, as I have struggled through the world in various fortunes ; but out of ages and ages of pleasure, greater farre then can be conceived by a heart of flesh ; and multiplied beyond the Arithmeticke of intelligences. And this happie moment, shall not be of their suddaine fleeting and expiring nature, that are assigned to time ; but shall endure beyond the extent of that time, which surpasseth al multiplication. I see plainly that I must multiply eternity, by eternity, to frame a scantling of that blisse, which a wel passed life in this world, shall bring me to in the next. And yet it will be as farre short, and as much beneath the selfe-blessednesse of him that giveth one this, as nothing is short of all that is. For my blisse shall have a beginning ; and though it never shall have end, yet that belongeth not to it for its owne sake, but proceedeth meerey from the bounteous hand of the nothing annihilating selfe essence : from whom there is no more feare of the sayling of his liberal superfluence of *Being* upon me, then there is of his own deficiency from being selfe *Being*. But how can these things stand together ? That indivisibly I shall possesse a tenure beyond all possible time ? and neverthelesse *possibly*, notwithstanding my possession, I may bee bereft of what I enjoy ? who can reade this riddle ? who can dive into

into this abisse? who can shoote light into this infinite pitt of dark enesse? It is the abundance and excessse of light that here striketh us blinde. Who can strengthen our eyes to endure eaglewise this glorious and resplendent sunne? Nothing sure in this world; unlessse it be silence and solitude. To these therefore let us consecrate the reverend contemplation of this awefull mystery; which is but profaned, if it be exposed to vulgar eyes: and to such night-owles and battes as we are, whiles the troubled fantasies of reeking sense and worldly occupations, do overcloud of my ary thoughts.

Now then if nature by short and thicke steps at the beginning, and by larger paces in the progresse, hath delivered us over into a night of pure light, where we can see nothing, because every thing is too visible; so that we are faine to vaile our eyes, and are constrained to retyre our selves to meditate and arme them, before we expose them to so strong and glorious beames: how should wee dare to looke upon those admirable heights (infinitely surpassing all these) with which the overconquering Grace hath crowned and swelled up the extent of nature? What sight is sharpe enough to penetrate into the mysterious essence, sprouting into different persons? Who can looke upon the selfe multiplyed unity, upon the incomprehensible circumincession, upon those wondrous processions, and idiomes reserved for Angels eyes?

Of these, (my soule) whose shootings reach infinitely higher beyond all that we have said, then what we have said is beyond the dull and muddy motions of this life; thou art not capeable now of receiving any instructions: let first the mystagogicall illuminations of the great Areopagite; and the Ascetike discipline of the Anachoreticall inhabitants of the wildernesse, purifie the eye, before thou attemptest to speake, or to aime at the discovery of these abissing depths. By them thou must be first irrigated with the sweet shoures of mornings and evenings, with the gentle deawes, and mannadrops, which fall abundantly from those bounteous favours that reside in a higher sphere then nature; and that poure out, unknowne and unconceivable blessings upon prepared hearts: which fructifie into that true blisse, in comparison whereof, all that we have hitherto declared, is but shaddow, vanity, and nothing.

F I N I S.

PRI.



PRIVILEGE DV ROY.

LOVYS PAR LA GRACE DE DIEV ROY DE FRANCE ET DE NAVARRE, A nos amez & feaux les gens tenans nos Cours de Parlemens, Baillifs, Seneschaux, Prevosts, leurs Lieutenans, & tous autres nos Justiciers & Officiers qu'il appartiendra, Salut, *Le Sieur Kenelme Digby Chevalier Anglois, nous a fait remon- strer qu'il a composé un Livre en langue Angloise, contenant deux Traitez, l'un de la nature du corps, & l'autre de la nature des ames, avec une recherche de l'immortalité de celles qui sont raisonnables. Lequel il desireroit mettre en lumiere & faire imprimer, s'il avoit nos lettres à ce necessaires: lequel les nous faisant supplier luy vouloir octroyer. A ces causes luy avons permis & accordé, permettons & accordons par ces presentes faire imprimer & debiter ledit Livre pendant six ans. Durant lesquels nous faisons defenses à tous Libraires & Imprimeurs de nostredit Royaume, de l'imprimer vendre, ny debiter, soit sous quelque marque de déguisement ou traduction que ce soit, sans le consentement dudit sieur Digby, à peine de trois mille liures d'amende, confiscation des exemplaires qui s'en trouveront, & de tous despens dommages & interells envers luy. Si vous mandons & à chacun de vous enjoignons tenir la main à l'execution des presentes, lesquelles voulons estre tenvès pour devèment significées, en mettant copie d'icelles au commencement ou à la fin de chacun desdits Livres. A la charge de mettre par ledit sieur Digby. une exemplaire dudit Livre en nostre Biblioteque, & une autre en celle de nullité desdites presentes. Car tel est nostre plaisir, nonobstant oppositions ou appellations quelconques, clameur de Haro, chartre Normande, & lettres à ce contraires. Donné à Fontainebleau le vingt-sixiesme jour de Septembre, l'an de grace mil six cens quarante quatre, & de nostre Regne le deuxiesme.*

Par le Roy en son Conseil,

LE MINISTRE DU ROY

OUVRAGE DE LA CLASSE DE DIEUX ROY
DE FRANCE ET DE NAVARRE A nos

seigneurs & seigneuses, nos Conscils de Paris, nos
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Par A. M. de C. de C.

CHATELAIN



